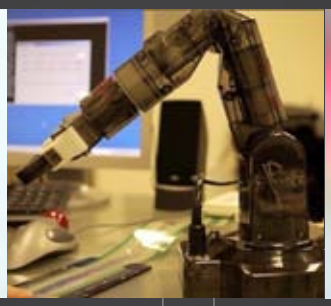
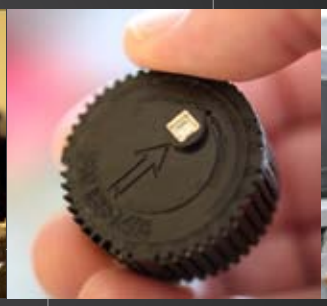
National Science Foundation

PHASE II GRANTEE ABSTRACTS

Division of Industrial Innovation & Partnerships


SBIR/STTR Phase II Grantee Conference

May 9th-12th, 2011 • Baltimore, MD

Preface

The Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program were conceived at the National Science Foundation (NSF). In 1976, Roland Tibbetts initiated an NSF program that would support the small business community with a specific objective to provide early-stage financial support for high-risk technologies with commercial promise. Today the government-wide program is administered by the Small Business Administration (SBA) and includes eleven federal departments that collectively award over $2 billion to small high-tech businesses.

NSF SBIR/STTR Program

The primary objective of the NSF SBIR/STTR Programs is to increase the incentive and opportunity for small firms to undertake cutting-edge, high-risk, high-quality scientific, engineering, or science/engineering education research that would have a high-potential economic payoff if the research is successful.

The current portfolio of NSF SBIR/STTR program covers four topic areas:

- **Biological & Chemical Technologies (BC)**
- **Education Applications (EA)**
- **Electronics, Information & Communication Technologies (EI)**
- **Nanotechnology, Advanced Materials & Manufacturing (NM)**

NSF SBIR/STTR Phase II Grantees Conference

The annual NSF SBIR/STTR Phase II Grantees Conference is an opportunity for small businesses that have received NSF Phase II awards and supplements to:

- Share technical and commercial achievements with the NSF Program Directors
- Receive educational information that is critical for small high-tech start-ups
- Learn about the various supplemental funding opportunities
- Network with other NSF SBIR/STTR grantees as well as potential investors and strategic partners

In the spirit of networking and resource sharing, we have designed this abstract book as a resource to NSF Phase II grantees, potential investors and strategic partners. We also hope to provide a snapshot of the current portfolio of NSF SBIR/STTR program.

To learn more about NSF SBIR/STTR Program, visit our website at http://www.nsf.gov/eng/iip/sbir/.

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BIOLOGICAL & CHEMICAL TECHNOLOGIES

Biological & Medical Technologies
Chemical Technologies
Environmental Technologies

Aquaculture Systems Technologies, LLC

Phase II Award No.: 0956749

Award Amount: $347,875.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Program Director: Anthony Walters

Sector: Biological and Medical Technologies

SBIR Phase II: Development of Design and Operational Criteria of Continuous Culture Hatchery Techniques for the Production of Brachionus rotundiformis (s-type) rotifers

This Small Business Innovative Research (SBIR) Phase II project's overall goal is to commercialize a robust, continuous culture production system for rotifers (Brachionus rotundiformis; s-type), the major live feed source for marine larval fish. A major bottleneck in the expansion of the marine aquaculture industry in the United States remains the lack of commercial live feed production technologies to support the grow-out industry. Specifically for rotifer culture, there exist limited standardized design and operational criteria for continuous culture methods that could facilitate increased productivity and consistency of supply. The inability to supply microalgal/zooplankton feeds cost-effectively (quantity) and consistently (quantity and quality) continues to be a major limitation to the expansion of the marine aquaculture industry.

The broader impacts of this technology are simplification of fingerling production which will lead to rapid expansion of marine hatcheries and hence a dramatic increase in the availability of lower cost marine fry and fingerlings for aquaculture grow-out in ponds, ocean cages and/or indoor recirculating systems. This research has the potential to help jump-start the marine aquaculture industry by eliminating one of the key limiting factors to increasing the production of many marine species, i.e. the unavailability and the high cost of fry and fingerlings. Aquaculture production of the more popular marine finfish will relieve the pressure on commercial fish stocks that are currently severely threatened or overfished and allow culture under highly controlled, biosecure conditions using commercial formulated diets.

ASL Analytical, Inc.

Phase II Award No.: 1058434

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Continuous Near Infrared Monitor for Pichia Pastoris Bioreactors

This Small Business Innovation Research (SBIR) Phase II project will further develop a fully hardened, user friendly ASL Pichia monitor for commercial protein production. The Phase I effort demonstrated the commercial feasibility of the continuous, real-time near infrared monitor for tracking metabolite levels and cell density during protein expression with Pichia pastoris. Implementing this technology into an industrial production or process development setting requires the entire system to be hardened and made more user-friendly. All hardware components will be incorporated into a single unit with an embedded computer and the sampling interface will be enhanced to permit continuous monitoring or discrete sampling. Protocols for calibration generation and updating will be established, and performance diagnostics to maximize calibration robustness developed. The final design of the instrumentation will be beta-tested by current Pichia users.

The broader impacts of this research will enable accurate control of bioreactors and enhance optimization efforts, resulting in maximum production yields of highly valued proteins from Pichia. Successful development of ASL's continuous, real-time monitor will enhance the attractiveness of Pichia as a protein expression platform. Acceptance of the monitor by the Pichia community will enhance efforts to develop new biopharmaceuticals and shorten the drug development process. ASL's monitor will catalyze the use of Pichia by enabling more effective control and optimization, thereby driving down healthcare costs and making these bio-therapeutic proteins more widely available. ASL's core monitor technology will be adaptable to broader markets with applications in biotechnology, biomedical, and clinical settings, where reliable, on-line sensing is currently unavailable.

BC Genesis

Phase II Award No.: 1026421

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Customizable Meniscus Implant Prepared by Dielectrophoretic Biofabrication

This Small Business Innovation Research (SBIR) Phase II project aims to develop a prototype meniscus implant of bacterial cellulose biomaterials fabricated by dielectrophoretic microweaving, an innovative biofabrication process. Nano-cellulose networks produced by the bacteria Acetobacter xylinum are biomaterials with unique hydrogel-like properties and biocompatibility that are ideal for cartilage tissue replacement. This technology is based on a new biofabrication process, in which bacterial motion is precisely controlled in an electric field to form nano-cellulose networks of desired morphology. Earlier feasibility studies have demonstrated bacterial cellulose deposition at the nanoscale during biaxial motion of bacteria in an electric field and the ability to control the assembly of cellulose layers into any desired three-dimensional architecture and control biomechanical properties. This Phase II project will develop a microweaver bioreactor for fabrication of customizable meniscus implants based on radiology images from patients. The structure and biomechanical properties will be evaluated in knee-model and compared with native meniscus. Biocompatibility and long term performance will be evaluated in large animal model studies.

The broader/commercial impact of this Phase II project, if successful, is the availability of meniscus implants that mimic the structure of the natural meniscus to address knee-joint failures, estimated to affect 15+ million people worldwide each year. Each year, in the US, more than 1 million people undergo meniscus surgery. Irreparable meniscus injuries often progress and lead to osteoarthritis. Currently, there is no satisfactory solution for irreparable meniscus injuries. The potential market for a meniscus implant is more than $3 billion. By developing a meniscus implant that can substitute for the injured native meniscus, it will be possible to prevent osteoarthritis and its related huge economic costs.

Bioo Scientific

Phase II Award No.: 0923854

Award Amount: $600,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Improved in Vivo Delivery of SiRNA

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop technologies that optimize the use of RNA interference (RNAi) in animals. RNAi is an invaluable tool for characterizing gene function and is a promising candidate for gene therapy. The use of RNAi in tissue culture is well developed but is of limited use in experimental animals. RNAi agents must enter cells to exert their effects but this has proven to be challenging in animals. The current lack of such technologies is holding back the majority of important RNAi animal experiments. To open this bottleneck, kits and reagents will be developed based on Bioo Scientific's Targeted Transport Technology (T3). Easy-to-use RNAi delivery products will be manufactured, validated and commercialized for use in animal experiments.

The broader impacts of this research are twofold. First, researchers will gain ready access to products that greatly simplify the use of RNAi in animals, thereby, stimulating a burst of validation experiments in animals to try to replicate prior results derived from tissue culture experiments. Animals are more complex than their tissue culture counterparts and it is uncertain that results can be duplicated in an animal. Second, T3 has the potential to be used for the therapeutic delivery of RNAi agents. In sum, this project will propel the validation of tissue culture results via T3 enabled animal experimentation, leading to a better understanding of cellular pathways, the identification of novel drug targets, and the potential to deliver RNAi agents as drugs.

Bioprocessing Innovative Company, Inc.

Phase II Award No.: 1026648

Award Amount: $500,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Engineering Clostridial Fermentation for Biobutanol Production

This Small Business Technology Transfer (STTR) Phase II project will develop novel engineered Clostridia strains for fermentation and economically produce butanol as a biofuel from sugars derived from starchy and lignocellulosic biomass. The conventional acetone-butanol-ethanol (ABE) fermentation has low butanol yield (<25%), butanol concentration (<16 g/L), and reactor productivity (<0.5 g/L?h) due to a strong butanol inhibition, and the fermentation process is difficult to improve due to the complicated metabolic pathways and gene regulation involved in the production microorganisms, mainly Clostridium acetobutylicum.

The broader impact/commercial potential of the project is to produce butanol as a biofuel from sugars derived from starchy and lignocellulosic biomass. Biobutanol has great value as an alternative transportation fuel. There is a huge potential commercial and societal impact in improving yields and reducing costs of butanol production. The research and other activity proposed could lead directly to a marketable product and process and leads to several enabling technologies, including better manipulation of C. tyrobutylicum, further demonstration of strain improvements using the FBB, and others.

Biosurfaces

Phase II Award No.: 0923674

Award Amount: $491,601.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

STTR Phase II: Localized Gene Delivery from Implantable Arterial Devices

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project is focused on assessment of our novel siRNA-loaded nanofibrous polyester in a rat carotid artery endothelial cell denudation model, which has been historically used to evaluate the effects of blocking specific genes on arterial healing. The goal of this Phase II proposal is to determine where these siRN-loaded nanofibrous materials can locally release a selected siRNA directly to the implant site and block selected cellular functions within the animal artery that are associated with blood vessel narrowing. Our hypothesis is that selected siRNAs can be incorporated into electrospun nanofibers using our patent-pending proprietary technology. siRNA would then be released from the respective material in a slow, sustained fashion, thereby directing cellular/tissue incorporation and transgene expression. It is anticipated that siRNA-loaded polyester materials will regulate cellular growth in and around the material as compared to untreated nanofibrous materials, thereby preventing blood clotting.

The broader impacts of this research are development of an implantable polyester material that can be used to locally deliver specific siRNA moieties directly at the implant site (i.e. within the artery). There is no other implantable material capable of directly affecting localized cellular function. Thus, this technology when employed as a stent coating or an artificial blood vessel will significantly improve patient outcome after implantation of these materials. Additionally, this type of material could be employed for simple (hernia repair mesh, catheter cuffs) or complex (total implantable heart, ventricular assist devices) devices that would require controlling specific cellular functions.

BioTools, Inc.

Phase II Award No.: 1058581

Award Amount: $431,690.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Vibrational CD Microscopy for Characterizing Supramolecular Bio-Chirality

This Small Business Innovation Research (SBIR) Phase II project is focused on the creation of a new revolutionary imaging instrumentation that combines vibrational circular dichroism (VCD) spectroscopy with infrared (IR) spectral microscopy. VCD microscopy represents a new class of spectroscopic imaging diagnostic capable of measuring VCD images with millimeter to sub-millimeter spatial resolution. The recent discovery that long-range structural chirality in protein fibrils is characterized by unusually large and distinctive VCD spectra provides the backdrop for this project. None of the currently available techniques can characterize the fibrillation pathway or the final fibril state with the same ease and detail as VCD. VCD microscopy can be thought of as circular polarization contrast microscopy that is sensitive to long-range chiral order in localized regions of biological samples.

The broader impacts of this research are studies of the supramolecular chirality of fibrils. This product is not a small improvement of an existing technology but a distinctly new method of studying long-range biochirality that is more sensitive, provides more detail, and is easy and fast to use. A secondary, higher-impact long-term impact will be clinical research laboratories where this innovation can be used for the detection and characterization of amyloids in vivo, i.e. for tissue biopsies, rapid detection of amyloids and drug screening.

Bridger Photonics, Inc.

Phase II Award No.: 0956910

Award Amount: $439,301.00

Start Date: May 1, 2010
End Date: April 30, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

STTR Phase II: Compact Aberration Compensated Focus and Scan Control for Biomedical Sensors

This Small Business Technology Transfer (STTR) Phase II project will develop a commercial prototype of an aberration compensated focus control device. This device, based on a MEMS technology, will allow the user to deflect a deformable membrane mirror in a controlled manner in order to select a desired focal length. The device also features active control of low-order aberrations. This technology will enable the next generation of biomedical imaging devices for microscopy applications by enabling focus control and aberration correction in a simple, compact and low-cost sensor.

The broader impacts of this research are primarily in biomedical imaging. An industry partner is interested in using the technologys aberration correction capabilities to improve skin cancer detection with their confocal microscopy product line. Microscopy and endomicroscopy researchers at the University of Arizona have stated that this technology will be a valuable asset in their research in the fight against cancer. The company will also team with a recognized leader in MEMS technology to enable enhanced imaging capabilities, primarily for imaging in the field of ophthalmology.

CertiChem, Inc

Phase II Award No.: 1026904

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Food Antioxidants (AOs) With or Without Estrogenic Activity (EA)

This Small Business Innovation Research (SBIR) Phase II project will use state-of-the-art assays to detect estrogenic activity (EA) and anti-EA in antioxidants (AOs). Chemicals like AOs that have EA or Anti-EA (EA**) produce adverse health effects, including reproductive and behavioral disorders and some cancers. AOs have not been examined for EA**, much less AO packages reformulated to have specific levels of EA for specific commercial applications. This project will assess the EA** of 10 additional organic AOs, and 15 EA-**Free/EA**-specified formulations made from combinations of conventional, organic, water-soluble, and oil-soluble AOs that are stable when exposed to common-use stresses. These AO formulations will be used by identified partners to produce animal feeds, cereals and other foodstuffs that are EA**-free or have well-specified levels of EA** providing a clear path to commercialization and additional patents.

The broader impacts of this research are that fetal or juvenile mammals, including humans, are especially sensitive to chemicals having EA** at very low dosages and should not indiscriminately ingest such chemicals. Conversely, other conditions (e.g., menopausal symptoms, some cancers or abnormalities of the prostate) are ameliorated by chemicals having controlled levels of EA**. Hence, this project will minimize the risks of unintentional consumption of chemicals having EA** by using EA**-free AOs in products such as cereals and baby formulas or specified-EA** AOs in products such as fitness drinks and dietary supplements for post-menopausal women.

ChromaDex Inc.

Phase II Award No.: 1058275

Award Amount: $500,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Microbial Production of Selected Anthocyanins

This Small Business Innovation Research (SBIR) Phase II project aims to develop and cost effectively manufacture natural anthocyanin colorants as alternatives to synthetic dyes. The food, dietary supplements and beverage market has decisively shifted towards utilizing natural colorants. Technologies available currently are not adequate to meet the current and projected demand for natural colorants cost effectively. The ChromaDex process utilizes microbial production techniques to manufacture high purity, low cost anthocyanins in large quantities for use as a natural colorant.

The broader impact of this research spans several industry segments. More and more synthetic dyes and colorants are being pulled from the marketplace due to health and safety concerns. Anthocyanin natural colorants eliminate the health and safety concern that is growing among consumers over the use of synthetic products in food and pharmaceuticals. These colorants can be utilized in natural dye sensitized solar cells, as anti-oxidant dietary supplements etc. Every pound of anthocyanin produced by the fermentation approach replaces an equivalent pound of synthetic colorant and helps to conserve the world's oil supply, protect the environment and provide safe food products.

Concurrent Analytical, Inc.

Phase II Award No.: 1026890

Award Amount: $381,132.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Sensitive, Rapid Heterogeneous Immunoassays Based on Surface Enhanced Raman Scattering and Gold Nanoparticle Labels

This Small Business Innovation Research (SBIR) Phase II project continues the development of an innovative diagnostic technology based on surface-enhanced Raman scattering (SERS) through its combination with gold nanoparticle labels, high-speed fluid handling, and sandwich-based immunoassays. This project, which builds on the successes of the SBIR Phase I effort, reflects a clear market need for high-speed, low-cost testing capable of providing rapid results commensurate with clinical diagnostic demands. As a market-entry point, the overarching goal is to create an extensible, multiplexed diagnostics platform for the causative agents of herpes: herpes simplex virus type 1 and type 2 (HSV-1 and HSV-2). Herpes has reached near pandemic levels in the United States and other countries around the world. The development of such a detection platform would have clear utility across the diagnostics marketplace, from the physician's office and in-hospital POC to third-party clinical diagnostic laboratories, as a multiplexed platform for sexually transmitted diseases and beyond.

The broader impacts of this research are realized with the development of a technique capable of providing absolute quantitation of HSV and many other viral diseases. Such a diagnostic tool would find a niche in large clinical laboratories, in research laboratories evaluating the antiviral efficacy of candidate vaccines, and with pathologists for defining infective pathogen thresholds, setting the stage for this technology to emerge as one of the premier tools in an arsenal of diagnostic technologies.

CoolSpine LLC

Phase II Award No.: 0923928

Award Amount: $599,925.00

Start Date: September 1, 2009
End Date: February 29, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

STTR Phase II: Intraventricular Cooling Catheter

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will build upon the success demonstrated in the Phase I program and further develop the Intraventricular Cooling Catheter, whose purpose is to induce localized therapeutic hypothermia while maintaining systemic normothermia and thus to act as a neuroprotective modality to mitigate brain injury in traumatic brain injury, and stroke, and post-cardiac arrest brain injury in humans. In Phase II our primary objectives are: 1) design and development of commercially viable prototypes of the system components (Controller and Catheter); 2) determination of system's range of effectiveness in cooling tissue in various regions of the brain (cooling map of brain); and 3) determination of system's safety and efficacy profile. Improvements will be developed to both the catheter and the controller based on our Phase I experience. Animal trials using a sheep model will be conducted to determine the system's performance and efficacy in brain application. Finally, an IDE safety trial will be conducted (in spine application). We anticipate that the results of this work will provide the foundation for this intraventricular cooling catheter to be used as an adjunct modality to other treatments for neuroprotection due to cerebral ischemia in stroke and traumatic brain injury, as well as in cardiovascular surgery.

The broader impact of this Phase II work addresses the challenge of neurological deficits relating to cerebral ischemia. Cerebral ischemia reduces oxygen delivery to brain cells and initiates the process of cellular death. Stroke and Traumatic Brain Injury (TBI) are the two most prevalent causes of icshemic brain injury. 780,000 strokes occur annually in the United States with 87% of them being ischemic. Stroke is the third leading cause of death and the leading cause of disability. Additionally, stroke strikes blacks at a rate twice that of whites. TBI results in 235,000 hospitalizations each year and 50,000 deaths. The challenge of TBI has increased even more in the US military where, due to the nature of modern warfare, rates of brain injury have increased from 12%-14% to an estimated 22%. Neurological deficits from cerebral ischemia cry out for novel therapies. Over $119 billion in direct and indirect costs to society are incurred annually from Stoke and TBI, $68.9 billion for stroke and 60 billion for TBI. These diseases affect all sectors of society and the development of a novel device to induce localized hypothermia while maintaining systemic normothermia will have a significant impact on clinical practice.

Curant, Inc.

Phase II Award No.: 0956890

Award Amount: $508,000.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Dynamic Device for the Treatment of Stress Urinary Incontinence

This Small Business Innovation Research Phase II (SBIR) project will develop a novel biomedical device to better treat stress urinary incontinence (SUI). SUI is a complex disease affecting millions of Americans in a debilitating manner which significantly impacts physiological and psychological wellness. The technology being developed is an implantable device for the treatment of SUI that will, as intentioned, be the first product to offer a universal, and more effective, solution to this multi-factorial problem. Building on the Phase I successful demonstration of technical feasibility, the main Phase II objective is to further refine and evaluate the device in preparation for future human trials. If successful, the device will simply and mechanically provide a reactional dynamic therapy that more closely resembles natural physiology than any other incontinence device currently available. This process will be empowered by focused research designed to analyze and better define the exact elements underlying the pathophysiology of SUI. This research will not only lead to a broader acceptance and understanding of the complexity of SUI, in both men and women, but also enable the company to optimize its technology. This project will be undertaken by the grantee in collaboration with leading urologists, engineers, and experienced entrepreneurs of the biomedical industry.

The broader/commercial impact of this project is advancement in understanding, acceptance, and treatment of urinary incontinence. Urinary incontinence is one of the most common chronic ailments; affecting over 25 million Americans and accounting for an extended yearly cost of more than $19.5 billion. Additionally, this condition is a leading contributor to the loss of self-dependency and nursing home admittance. If successful, the technology will address a critical societal need with a device that offers a cure to underserved patients rather than a palliative compromise. The implications of this technology extend beyond urinary incontinence and should create opportunities to advance patient treatment for conditions such as fecal incontinence, gastro-esophageal reflux disease, and glaucoma.

EarthGenes Pharmaceuticals

Phase II Award No.: 0924699

Award Amount: $600,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

STTR Phase II: An Advanced Antibiotic Screen of Marine Environmental DNA through a Metabolically Engineered E. coli Strain

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project offers a novel route to finding critically needed new antibiotics. The emergence of antibiotic-resistant bacterial pathogens is a growing medical challenge, urgently requiring new drugs. Natural products, synthesized primarily by environmental microorganisms, have supplied most of the current arsenal of effective antibiotics. However, the discovery rate of new antibiotics has greatly diminished. With the recent understanding that the vast majority of environmental microorganisms have never been screened for the production of antibiotics because they cannot be easily cultured in the laboratory, EarthGenes has developed a technology to access these organisms, involving extracting environmental DNA, cloning large fragments into specialized vectors to create DNA libraries, expressing these libraries in suitable easily-grown surrogate hosts, and screening the libraries for antibiotics encoded by the environmental DNA. Professor Blaine Pfeifer at Tufts University has developed the most advanced bacterial host for expressing environmental DNA, potentially improving the efficiency of this technology. Thus, the EarthGenes-Tufts collaboration is designed to lead to the discovery of new, more potent antibiotic drugs.

The broader impacts of this research include a technology to provide a new, continuous supply of potent antibiotics to treat infectious diseases, thus addressing a critical health-related goal with technical innovation. The technology can also be extended to other disease areas. The impact is augmented by education and outreach, including the education of undergraduates, graduate students, and postdoctoral associates, with mechanisms in place to attract underrepresented students from diverse backgrounds.

ENDOMETRIC, LLC

Phase II Award No.: 0956847

Award Amount: $549,735.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Real-time Analysis and Feedback during Colonoscopy to improve Quality

This Small Business Technology Transfer (STTR) Phase II project will develop an assistive software tool for endoscopists to have real-time feedback of objective quality for colon and potential polyp region examinations. The technology is aimed to reduce polyp miss rates during colonoscopy. Colonoscopy has contributed to a marked decline in colorectal cancer related deaths. However, recent data suggest that there is a significant miss rate for the detection of even large polyps and cancers. Studies suggest that polyp detection rate may be related to the duration of the withdrawal phase of the procedure and cancer miss rate is related to the identity of the endoscopist performing the procedure. This tool, which will provide video stream analysis and feedback during live colonoscopy, is made up of novel middleware software to ensure high performance execution of video analysis on an affordable workstation, and are generic, reconfigurable with new task allocation that support time-constraint video analysis. Objective metrics for real-time feedback are derived from real time analysis that will address complexities arising from blurry frames, stool, camera movement patterns, and regions of appendiceal orifice and polyps. Technical insights learned from development of this tool for colonoscopy may be applicable to new research on quality control using videos generated in other areas of medicine, such as bronchoscopy, cystoscopy, arthroscopy and laparoscopy.

The broader/commercial impact of this project, if successfully implemented in large-scale day-to-day medical settings, will be higher quality of care for patients undergoing colonoscopy procedures with real time objective quality assessment, which is currently not feasible. Over 14 million colonoscopies are performed annually in the US. This assistive tool will stimulate high quality inspection, while documentation is done. That will mean that endoscopists will be able to spend more time on performing the colonoscopy and less time on documentation. Hospital/clinic administrators will be able to run endoscopic facilities more efficiently. Insurance companies may benefit from better documentation and lower costs since fewer patients will require extensive cancer treatment as the frequency of missed polyps and early cancers declines. This assistive tool is also expected to contribute to medical education, research, and practice by providing automated feedback during teaching and training of novice endoscopists or continuing education for experienced endoscopists.

EndoShape Inc

Phase II Award No.: 0823015
Phase IIB Award No.: 1044911

Award Amount: $574,582.00

Start Date: July 1, 2008
End Date: December 31, 2011

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Sector: Biological and Medical Technologies

SBIR Phase II: Shape memory polymer AAA Endograft

This Small Business Innovation Research (SBIR) Phase II project aims to continue the development of novel endografts for percutaneous treatment of abdominal aortic aneurysms (AAA) using unique and proprietary shape memory polymer (SMP) technology. Abdominal aortic aneurysms are both common and lethal in the older population, affecting between 7 and 13% of older persons (> 60 years), accounting for between 13,000 and 18,000 deaths per year in the US alone, and increasing in diagnostic prevalence as both diagnostic techniques improve and the population ages. Endovascular treatment using covered stainless steel or Nitinol stent-grafts is now the preferred option for AAA treatment. However, current devices are far from perfect, and complications from endovascular repair such as endoleaks, continued growth of the aneurysm, device migration, arterial dissections, and other problems persist at very high (> 25-35%) rates. Most if not all these problems can be traced to the inherent limitations of the materials used in current devices. We propose to continue the highly promising Phase I work with particular focus on four areas: finalize polymer formulation; develop methods to manufacture patient-specific endograft designs; finalize biocompatibility evaluation; and evaluate endografts in acute and chronic animal studies. Anticipated deliverables at the end of the Phase II project are a finalized polymer formulation particularly suitable for endografts, complete ISO 109993 biocompatibility evaluation, methods to manufacture patient-specific endografts, and comprehensive data on the acute and chronic vascular response of the shape memory polymer endografts.

The broader impacts of this work lie in the development of the next generation of medical devices using advanced materials with characteristics that can be customized to the patient. The successful development of useful devices from such technologies should pave the way for a plethora of commercial opportunities including tissue-engineering applications whereby the "seeds' of new tissues or organs can be incorporated into shape memory polymer devices and delivered using minimally invasive methods into the target site to eventually grow healthy tissue. The ability to fuse shape memory polymer technology with advanced three-dimensional imaging and automated manufacturing methods, such as rapid prototyping and stereo-lithography, promises to open up the exciting prospect of creating patient-specific devices within the operating suite; devices that once manufactured can be compacted in situ into a catheter and delivered immediately into the patient. Lastly, successful completion of the overall project should have immediate impact on a disease that is the 13th leading cause of death in the US, and consequently on human health.

Equinosis LLC

Phase II Award No.: 1026883

Award Amount: $499,264.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Inertial sensing of animal locomotion

This Small Business Technology Transfer (STTR) Phase II project proposes to further investigate use of a body-mounted, inertial sensor motion analysis system as a field-ready, objective evaluation technique to detect and evaluate locomotion disturbances in the horse. Research objectives involve incorporating the Hilbert-Huang transform into analysis algorithms, test another common gait, the canter, test unique gaits of popular breeds in the United States, expand application to detect and evaluate ataxia in horses and lameness in dogs, further investigate the ability of the system to differentiate impact from pushoff lameness, further investigate if specific, naturally-occurring lameness conditions can be differentiated by analysis, investigate the impact on analysis of adjusting for torso rotation, and investigate developing an additional data acquisition device for veterinarians to prescribe to clients as a monitoring tool.

The broader impacts of this research are improving veterinary service provided to horses and dogs and generally enhancing animal health and well-being. Education of veterinary students will be improved by basing teaching on objective measurement rather than subjective opinion. Accurate detection and evaluation of lameness in horses and dogs and ataxia in horses early in the course of disease may save money and improve therapeutic outcomes if treatment is initiated when it may be most effective and provide the practicing veterinarian with more objective evidence on when and what diagnostic modalities have the greatest potential to achieve accurate and specific diagnosis. Successful commercial development of this technology will stimulate the economy, providing a value-added service previously unavailable.

Expansyn Technologies, Inc.

Phase II Award No.: 0936151

Award Amount: $491,521.00

Start Date: January 1, 2010
End Date: December 31, 2011

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Evaluation of recombinant HED2 proteins as synergists for cellulosic biofuel production

This Small Business Innovation Research (SBIR) Phase II project will use a Homolog of Expansin Domain-2 protein to enhance cellulose performance in large-scale biomass digestion into sugars for biofuel projection. Due to the economics, politics and environmental impacts of reliance on petroleum-based fuel, there is growing interest in using biofuel. Cellulosic biomass provides a readily-available, high-volume feedstock for biofuel production. Successful completion of the objectives will optimize unpurified ZM3 for use as a cellulose synergist in scaled-up conditions for commercialization purposes.

Broader impacts associated with developing strategies to decrease the costs and improve the efficiency of the production of ethanol from cellulosic biomass include numerous societal benefits resulting from reduction of petroleum use. Conversion of cell wall biomass from renewable forestry and agricultural feedstocks into biofuels enables the efficient use of waste materials. From an environmental standpoint, the widespread use of cellulose-based biofuel as an alternative renewable energy source could substantially reduce greenhouse gas emissions due to the ability of plants to remove CO2 from the atmosphere.

Fibron Inc.

Phase II Award No.: 1058598

Award Amount: $488,741.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Biological and Medical Technologies

STTR Phase II: Polyaniline Nanofiber Urinary Tract Infection Biosensor-A Multi-Functional Bioresponsive Material

This Small Business Technology Transfer Research (STTR) Phase II project is for the development of an inexpensive, rapid, high-accuracy test for the detection and identification of the pathogens that cause urinary tract infections (UTIs). Currently, UTI diagnosis is an expensive and lengthy process that often results in patients given unnecessary or ineffective antibiotics. This pathogen detection system utilizes highly dispersible polyaniline nanofibers that bind to markers in urine to generate a visible change in solution with the appearance of nanofiber aggregates. Versions of this test will be optimized for UTI detection, leukocyte detection and pathogen identification. An array of nanofibers functionalized for detection of different bacterial markers will be used for demonstration of pathogen identification.

The broader impacts of this research are increased access to accurate tests for pathogen identification, healthcare cost reduction and reduction of antibiotic resistance. The low cost and ease of this test will allow patients to get diagnosed expeditiously, and then treated properly using species-directed medication rather than broad antibiotic coverage. This will have a great impact on decelerating the rise of antibiotic resistance. This test also has potential with future development in other target detection applications such as food/water testing and meningitis. Researchers may also benefit from this development as an alternative to more expensive and slower routes for identification of pathogens like culture. The overall cost reduction associated with this method of marker detection may also increase access to better infection diagnosis and treatment to lower income populations and patients in third world countries.

GrassRoots Biotechnology, Inc.

Phase II Award No.: 0957836

Award Amount: $500,000.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Sector: Biological and Medical Technologies

STTR Phase II: Constitutive Promoters for Crop Improvement

This Small Business Technology Transfer (STTR) Phase II project seeks to identify new and improved promoters to create enhanced genetically modified crops. Plant biotechnology relies on the insertion of promoter-gene constructs into plants. The promoter is the portion of DNA that controls when and where a gene is expressed. The relatively few plant promoters in use today have significant limitations including inconsistent effects across different growing conditions and a lack of predictability. This project involves developing and implementing a novel pipeline for promoter discovery that starts with a sophisticated bioinformatics analysis to identify high confidence promoter candidates. Using fluorescent reporters and confocal imaging, these candidates are assessed in transgenic plants for cell-type-specific expression, developmental-stage-specific expression, and responsiveness to environmental stimuli. This pipeline was validated in the Phase I component of the project where four novel and patentable constitutive promoters were identified.

The broader impacts of this research are the development of superior genetically modified crops. Genetically modified plants already play an important role in world agricultural production and will play a central role in averting widespread food shortages in the future. In addition, substantial research is being conducted to improve bioenergy crops though genetic engineering. Genetically enhanced bioenergy crops are predicted to play a key role in reducing our dependence on fossil fuels and in cutting greenhouse gas emissions. A critical innovation that will facilitate advances in all of these areas will be the introduction of new and enhanced plant promoters.

HEPREGEN

Phase II Award No.: 0956888

Award Amount: $500,000.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Sector: Biological and Medical Technologies

SBIR Phase II: Development of a Human Liver Platform for High-Throughput Screening of Drug-Induced Liver Injury and Drug-Drug Interactions

This Small Business Innovation Research (SBIR) Phase II project is aimed towards development of a human micro-liver platform and assay technologies for cost-effective, high-throughput, and quantitative screening of drug-induced liver injury (DILI) and drug-drug interactions (DDI) following chronic exposure to pharmaceuticals. While primary human hepatocytes isolated from the liver are widely utilized in the pharmaceutical industry for drug screening, these cells rapidly (hours) lose phenotypic functions under conventional culture conditions. Recently, a human liver tissue model with defined microscale architecture has been developed that maintains phenotypic functions of primary hepatocytes for several weeks in vitro (micro-livers). This project proposes to develop assay technologies (gene expression, reporter-based, and high content imaging) with micro-livers in a high-throughput multi-well format for DILI and DDI screening in early drug discovery.

The broader impacts of this research are novel approaches for the development of high-throughput, physiologically-relevant platforms for assessing the potential of compounds to cause adverse effects on organs. The liver platforms developed here may enable the elimination of drugs with problematic toxicity profiles much earlier in the drug development pipeline towards substantially reducing the cost to develop a successful drug ($1 billon per drug), increasing the likelihood of clinical success, and limiting human exposure to unsafe drugs. In the future, these platforms may be useful for evaluating the injury potential of environmental toxicants, in fundamental investigations of liver physiology and disease, and for personalized medicine.

Inscent, Inc

Phase II Award No.: 0956877

Award Amount: $505,014.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Development of Novel Repellents for the Honeybee, Apis Mellifera

This Small Business Innovation Research (SBIR) Phase II project provides the scientific foundation for a paradigm shift in insect pest control away from traditional insecticides to products that alter insect behavior by manipulating insect chemosensory proteins. We used rational design to isolate compounds that bind to critical insect chemosensory proteins, and are isolating those compounds capable of altering insect behavior. In response to citrus grower demand we have isolated small molecules that have the potential to alter the foraging behavior of the agriculturally and economically significant insect, Apis mellifera (European honeybee). Our final products will be repellents capable of protecting citrus from unwanted pollination. The technologies utilized here are applicable to the development of control products for other insect pest species, including insect carriers of human disease and insect pests of economic, agricultural, or domestic significance.

The broader impacts of this research are avoiding the use of insecticides and expanding our ability to control insect behavior. The initial insect targeted, the European honeybee (Apis mellifera), provides essential pollination that adds an estimated $14 billion annually in value to US crops. However, unwanted honeybee pollination severely decreases the value of mandarin crops, leading to the need for an effective bee repellent that is safe for bees and humans alike. Similar approaches are currently underway to control other important agricultural and public health pests. This project utilizes novel methods with the potential to transform the way insect control products are designed and utilized.

Insite Medical Technologies

Phase II Award No.: 0848916
Phase IIB Award No.: 1112846

Award Amount: $1,000,000.00

Start Date: January 15, 2009
End Date: June 30, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Improving the safety and efficacy of epidural anesthesia

This Small Business Innovation Research (SBIR) Phase II project is focused on commercializing a proprietary medical device to provide safe and accurate delivery of epidural anesthesia. Epidural anesthesia provides excellent pain control for childbirth, major surgery, and chronic back pain without having to expose patients to the risks of general anesthesia. Epidural anesthesia involves (1) accessing the epidural space, a miniscule potential space adjacent to the dura, the thin protective covering of the spinal cord, then (2) delivering local anesthetic to bathe the spinal nerve roots and block pain sensation. Currently, epidural access requires blind insertion of a sharp-tipped needle through the back that is immediately halted just prior to entering the dura. The difficulty of the current method poses risks of anesthetic delivery to incorrect anatomic locations and injury to nearby critical structures. Complications are estimated to occur in 6-25% of cases. InSite Medical Technologies has developed a technology that eliminates the sharp needle tip and provides highly controlled access to the epidural space by uniquely engaging surrounding tissue. During the Phase II project InSite will finalize product design, establish a quality manufacturing system, attain an FDA 510(k) approval and achieve the first human use of the device. The epidural anesthesia market comprises an estimated 9.8 millions eligible patients each year in the United States of which only 3.4 million patients actually receive epidural anesthesia.

The underutilization of epidural anesthesia results from several barriers including procedure difficulty and physician fear of complications. The epidural anesthesia market is segmented into obstetric, surgical, and chronic pain applications. With over 4 million births annually in the United States, obstetrics is the largest segment. Currently, during childbirth, 2.4 million women (60%) receive epidural anesthesia for pain control. The second largest segment is surgical anesthesia where, despite known patient-outcome benefits, epidural anesthesia is used in only 500,000 of 1.8 million eligible cases. Finally, spine-related pain syndromes are treated increasingly with epidural steroids and implanted stimulators, accounting for 600,000 annual cases. Outside the U.S., 19 million epidural access procedures are performed annually with a massive potential international market including 130 million births per year. By creating a safer and more accurate system for delivering epidural anesthesia, InSite Medical Technologies sees an opportunity to produce a premium medical device that positively impacts patients' experience with epidural anesthesia.

InstaRecon, Inc.

Phase II Award No.: 0750502
Phase IIB Award No.: 1063576

Award Amount: $521,394.00

Start Date: March 15, 2008
End Date: August 31, 2011

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Sector: Biological and Medical Technologies

SBIR Phase II: Ultra-Fast Software Image Reconstruction for Micro-CT

The SBIR Phase II project aims to develop a software package that enables rapid image reconstruction for X-ray Micro-CT (computerized Tomography) imaging. Over the last few years, Micro-CT has become a very valuable tool in pharmaceutical and basic research. Current Micro-CT scanners have reached a resolution of 1 micrometer and thus allow high resolution in-vivo and ex-vivo three dimensional examination of entire small animals such as mice. Other applications of Micro-CT range from functional imaging to use in material science. Yet, high resolution reconstruction of a single data set can be extremely time intensive, thus limiting the use.

If analysis software capable of speeding up image reconstruction by 2 or 3 orders of magnitude can be developed, such software would significantly decrease the time to analyze high-resolution Micro-CT images and would thus increase the utility of this powerful imaging method.

Kona Blue Water Farms, LLC

Phase II Award No.: 1026645

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Launching Velella: Testing the Commercial Potential of Mobile Offshore Fish Farming In Ocean Gyres

This Small Business Innovative Research (SBIR) Phase II project will catapult open ocean mariculture far offshore, away from the restrictions caused by competing user groups, site lease requirements and mooring restrictions, by developing the technology for Velella - an untethered, open ocean regional drifter cage. Since 2005, Kona Blue's open ocean mariculture operation has produced up to 500T per annum of Kona Kampachi, with negligible environmental impacts, from a 90 acre site. Growth and investment are constrained by site limitations. Mariculture expansion in U.S. waters is similarly limited by regulatory constraints for moored structures, and the technological challenges of operating further offshore. The Velella Project is developing essential technologies for drifter net-pens that can be entrained in regional ocean eddies. This will allow increased scale and reduced labor requirements, and greater farm profitability. Phase II will also expand eddy predictive capabilities, and launch a Velella beta-system maiden voyage.

The broader impacts of this research are to be accrued through benefits to the environment, coastal economies and public health. The oceans are in deep trouble; over 90% of the ocean's larger predator fish are gone, and over a quarter of fish stocks have 'collapsed'. Heavily exploited or overfished wild stocks cannot meet the growing global demand for healthful seafood. Still, increased seafood consumption is imperative for American consumers' health. Inshore and onshore aquaculture offer only limited expansion opportunities, or lower-value products. Open ocean mariculture can meet this burgeoning demand, improve product quality and reduce pressure on wild stocks. Overcoming the industry constraints requires highly-automated husbandry systems, and demonstration of a scalable production model for deep water that meets current regulations. This research could significantly expand sustainable, eco-friendly mariculture in U.S. waters, without environmental impacts or user-group conflicts associated with other site-constrained aquaculture. Increased automation can increase production volumes and improve profitability, fish health and worker safety offshore. Increased domestic mariculture could reduce America's $9 billion seafood trade deficit.

Louisville Bioscience, Inc.

Phase II Award No.: 1026824

Award Amount: $499,826.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Plasma Thermograms for Disease Detection and Monitoring

This Small Business Innovation Research (SBIR) Phase II project will develop a powerful new diagnostic assay platform that will form the basis of a novel high-throughput diagnostic assay for detection and differential diagnosis of six autoimmune diseases: Lupus, Rheumatoid Arthritis, Multiple Sclerosis, Scleroderma, Polymyositis, and Lyme disease. Assay output is a differential scanning calorimetry (DSC) thermogram that is a characteristic signature for an individual's plasma or serum. The characteristic pattern provides a quantitative measure of the manifold components comprising an individual's plasma/serum, thereby providing an entirely new metric with which to analyze the fluids. The goal is completion of the necessary R&D objectives required to build a prototype diagnostic assay based on the plasma thermogram technology platform. Activities and experiments are directed at automating and optimizing laboratory assay capabilities; defining essential assay parameters and quantitative metrics; and testing and validating the prototype assay.

The broader impact/commercial potential of this project is the radical alteration of treatment paradigms, improved patient outcomes and reduced costs of patient care for complex diseases like autoimmune diseases. As many as 24 million people in the USA are affected by autoimmune disease. Convenient, quantitative and cost-effective diagnoses for numerous diseases, including targeted autoimmune diseases are not readily available. Early differential diagnosis between these diseases is an important unmet medical need and critical for timely and accurate treatment of disease and its complications. In addition, early accurate diagnosis potentially mitigates the costs and inconvenience associated with redundant administration of the current immunological, serological, clinical and pathological tests. Thus, a non-invasive blood assay like the plasma thermogram test that can differentially diagnose autoimmune diseases will be highly beneficial. The company will establish a CLIA (Clinical Laboratories Improvement Act) laboratory from which to market and sell the plasma thermogram test. A central laboratory offers a fast, low cost and high revenue business model for introducing new diagnostic tests into the marketplace. Commercialization of the thermogram technology platform represents a potential multi-million dollar market opportunity.

Lucigen Corporation

Phase II Award No.: 1058238

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Molecular diagnostics and biological control of disease in farmed channel catfish

This Small Business Innovation Research (SBIR) Phase II project is aimed at developing an effective, inexpensive, safe means of controlling diseases in farm-raised catfish. One of the biggest problems in farm-raised catfish is disease that occurs in commercial ponds. Scientists at Auburn University discovered strains of natural bacteria that can be applied to fish feed to control the most common diseases. Lucigen is developing rapid, simple tests capable of detecting these diseases before the fish get sick. The goal is to combine these ideas to develop commercial products to rapidly diagnose and treat the most common catfish diseases.

The broader impacts of this research are 1) the preservation of an important industry in economically disadvantaged regions of the rural southeastern US and 2) protection of an increasingly important food source. Since yields of most wild-caught fish are declining, farmed fish are becoming an important food source and an important industry throughout the world. Fish diseases in aquaculture ponds cause losses of up to half the fish before harvest, costing billions of dollars worldwide, and there is no satisfactory means of controlling most of these outbreaks. Antibiotics, vaccines, chemicals or controlled feeding are all prohibitively expensive, harmful to human and environmental health and/or bad for yields. The detection and control of catfish diseases, the immediate focus of this project, addresses the $20-30M in annual losses caused by disease. Longer term, similar biological control systems should be applicable to other fish species in the US and the rest of the world.

Lumetrics, Inc

Phase II Award No.: 0923963

Award Amount: $497,179.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Biological and Medical Technologies

SBIR Phase II: Fiber-optic System for Fast Non-contact Measurements of Optical Structure of Human eye

This Small Business Innovation Research (SBIR) Phase II project is aimed at developing a high speed and high sensitivity system for measuring optical dimensions of human eye, such as the total axial length, corneal thickness and the location and thickness of the crystalline lens, in a non-contact manner using infrared light, invisible to the eye. This task is accomplished by improving the existing technique of time domain low-coherence interferometry. In case of a live patient, who cannot be immobilized for steady measurements, speed and sensitivity of the measurements are especially important to achieve high accuracy and precision.

The broader impacts of this research are aimed at benefiting large part of the population that suffers from cataract and other vision problems. The U.S. population of over 65 years old expected to increase to over 70 million in 2030. Therefore, there is a dramatic need for tools to treat the wave of eye diseases and problems inherent to such population. Information on the structure of the eye is required in eye surgeries, including those that deal with replacing the crystalline lenses affected by cataract. The proposed research will result in an array of critical tools aimed at mapping out the eye, for medical research and for treatment of the diseases.

Marker Gene Technologies, Inc.

Phase II Award No.: 0923953

Award Amount: $699,889.00

Start Date: August 15, 2009
End Date: July 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: New Labeling Reagents for Genetic Analysis

This Small Business Innovation Research (SBIR) Phase II project aims to develop new, sensitive, accurate, and reliable detection methods for measuring genomic DNA or RNA samples isolated from living cells. The intellectual merit of this project lies in the development of new detection methods that are essential for improving high-throughput genomic microarray analyses of gene activity. Problems with current microarray and genomic analysis techniques, including hybridization perturbation, slow enzymatic labeling methods using expensive labeled nucleotides and sequence dependence, are solved using a direct labeling approach. These new systems will provide the detection tools needed to advance the promising pharmaceutical, research and diagnostic uses of genomic analysis to determine the pattern of gene expression in disease or upon therapeutic treatment. Marker Gene Technologies, Inc. has established the feasibility of these detection methods by preparing new ultrasensitive fluorescent labeling reagents and developing protocols for directly labeling DNA or RNA samples isolated from live cells. These reagents are able to efficiently and sensitively label oligonucleotides for high-throughput microarray analysis. In Phase II these systems will be validated by further analysis of the fluorescent labeling methods and characterization of their ability to monitor changes in gene expression upon application of drugs or other bioactive compounds or in response to biological changes in cell function or disease, in a cell-specific manner.

The broader impacts of this project include development and commercialization of new methods for rapid screening of genomic expression patterns in response to specific drug application in normal cells and tissues as well as in disease, bacterial or viral infections. These methods are a significant improvement over existing technologies by using a direct labeling approach that is quicker, more accurate and more cost-effective. These systems will be marketed to the pharmaceutical and diagnostics industries for high-throughput pre-clinical screening of drug efficacy by comparative cellular genomic analysis. In addition, existing collaborations with industrial and research partners assure quick commercial development of the technology. The combined techniques will improve U.S. competitiveness in the burgeoning genomic analysis field as well as in pharmaceutical therapeutic drug development and lead to further job creation based on both the products and systems developed.

Marrone Organic Innovations, Inc.

Phase II Award No.: 0750549
Phase IIB Award No.: 1032645

Award Amount: $1,116,000.00

Start Date: March 1, 2008
End Date: February 29, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

STTR Phase II: Commercialization of an Innovative Green Technology for Controlling Zebra Mussels

This Small Business Technology Transfer (STTR) Phase II research project is focusing on the development and commercialization of a new, environmentally safe biopesticide for the control of zebra and quagga mussels. These freshwater, invasive bivalves foul water pipes and cause severe economic and ecological harm throughout North America and Europe. Marrone Organic Innovations, a leader in biopesticide commercialization, is partnering with biological control experts at the New York State Museum who have discovered a bacterium, Pseudomonas fluorescens, that produces a natural compound that is selectively lethal to these pest mussels. The microbial biopesticide developed in this project will be an environmentally safe alternative to the polluting, non-selective chemicals that infested facilities, due a lack of alternatives, are currently forced to rely on to control mussel infestations.

The broader impacts of this research include both economic and ecological benefits to society. Mussel infestations cause hundreds of millions of dollars in additional expenses every year, and the chemical methods currently used to control them are known to be harmful to other aquatic organisms. The proposed research will advance a project of national significance and reach across numerous scientific disciplines, including biochemistry, microbiology, and invertebrate zoology, serving as a model in the effort to reduce the use of polluting pesticides. Training and learning will be fostered by involving postdoctoral, graduate, and undergraduate students. Because of its extraordinary safety, this bacterial biopesticide will serve as an example of a green technology that will benefit the environment as well as industrial and recreational users of freshwater.

Medipacs Inc

Phase II Award No.: 0848528
Phase IIB Award No.: 1042566

Award Amount: $1,000,000.00

Start Date: January 15, 2009
End Date: December 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Dendritic Hydrogel Actuators for a Liquid Drug Delivery Patch

This Small Business Technology Transfer (STTR) Phase II project will develop a class of new, stable, highly responsive Electro Active Polymer (EAP) hydrogel actuator materials. Incorporating dendrimers (dendritic macromolecules) and hyper branched polymers as chemical cross-linking agents into a poly(ethylene glycol) (PEG)-based EAP hydrogel to increase cross-linking densities at low polymer concentration will introduce systematic control of physical properties and performance through structural variables provided by the dendrimer (e.g. generation; end groups; branching ratio; subunit structure). Our research objectives involve the preparation of dendrimer containing PEG hydrogels and the investigation of dendrimer mole fraction, structure, and molecular weight on the stability, strength, physical and responsive properties of the hydrogel material. The new hydrogel actuator materials will enable low cost miniature infusion pump technology. These actuators will be the pump mechanism of a disposable (low cost), small patch like, device being commercialized by Medipacs as the Mini Infuser. The Mini Infuser is a miniature, disposable, programmable drug delivery device designed to significantly lower the cost of patient care while improving a patient's lifestyle with increased pharmacological safety, patient mobility and fewer needle sticks. Medipacs is collaborating with the University of Arizona Chemistry Department to develop the first generation commercial prototype in the Phase II project.

Broad application of this technology will impact and lower the cost of healthcare not only for millions of infusion patients but also the industry providers. The projected market in the United States alone is greater than $3 billion. The impact to poorer regions though out the world is immeasurable; life-improving drug therapies such as low cost continuous insulin delivery will be enabled and become available for the first time to patients within these regions.

NovaScan LLC

Phase II Award No.: 1058413

Award Amount: $498,074.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Electrical Property Detection of Residual Cancer in the Surgery Suite

This Small Business Innovation Research (SBIR) Phase II project aims to bring to market a hand-held probe used by the surgeon to ascertain that the surgical wound and regional lymph nodes are clear of cancer. This technology will provide a highly innovative, rapid and accurate device for detecting cancerous tissue by interrogating the electrical properties of the tissues. Currently, removal of affected tissue must be confirmed in the pathology laboratory resulting in delays of up to 36 hours. If the residual cancer is left undetected the patient may be subjected to multiple surgeries or worse, may have a reoccurrence of the disease. This innovative technology will provide surgeons with a tool to ensure all cancer is removed, assist pathologists to help identify malignancies, and provide better results for breast surgery patients to avoid second or third surgeries.

The broader impacts of this research will be the development and implementation of a novel, accurate, rapid, inexpensive, non-invasive, low power, hand-held probe that can assist the surgeon in the removal of all of the cancerous tissue and assist the pathologist in the diagnosis of specific tumor regions. Cancer is a major health problem in the US with over 1.4 million new cases and 560,000 deaths at a cost of $72 billion each year. In particular, the detection of breast cancer has serious drawbacks: cancer is hard to find in dense breast tissue, often depend on the use of invasive contrast agents, and advanced detection technologies are expensive and not available to the entire population. In addition, some types of tumors are not easily identifiable. Surgical procedures are safe only if all cancer is removed. Clearly, there is a pressing need for new technologies that would improve the detection of cancerous tissue.

OndaVia, Inc.

Phase II Award No.: 0924350

Award Amount: $600,000.00

Start Date: September 15, 2009
End Date: February 29, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Water and Food Analysis by Non-Uniform Electroosmotic Flow

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will result in a prototype portable instrument for water quality analysis. The Phase I SBIR project was designed to show the feasibility of a new technique for separating uncharged polymers; this objective was met with remarkable quantitative accuracy, setting the stage for this Phase II prototype project. The underlying Phase I effort was based on stochastic mathematical models and molecular dynamics simulations through which the Labrador Research team discovered an electrokinetic approach for the separation of uncharged polymers. As efforts progressed, the power and potential of this approach as a generic separation technology became evident as our commercialization approach evolved into addressing the market need for water- and food-quality analysis technologies.

This Phase II project will lead to a commercial prototype through iterative design improvements coupled with validation testing. The results obtained during Phase I and the anticipated Phase II results will set the stage for Phase III commercial participation by our financing partners and for rapid deployment of this proprietary chip technology in portable, hand-held analytical instruments. The world is running out of "quality" water for drinking and agricultural purposes. At the same time, public health agencies do not have the time, equipment, or resources to proactively check for hazardous chemicals in our drinking water, our water sources, or our food on a routine basis. Recent scares regarding melamine in baby food and pet food, bisphenol A in drinking water bottles, or perchlorate in ground water demonstrate the fragility of the water and food systems. Typical analysis requires collecting a sample in the field and shipping the sample to a test laboratory; water monitoring agencies depend upon these outsourced laboratories where transport and processing time can take days to produce results, wasting precious time when the health of a community is at stake. Existing portable tools can measure a few parts per million, whereas hazardous compounds are often regulated in the part per billion range. Handheld tools that measure a wide array of compounds at a parts-per-billion or better level would be a powerful, valuable, and necessary addition to the analysis toolbox.

Oragenics Corporation

Phase II Award No.: 0749884
Phase IIB Award No.: 1041608

Award Amount: $1,000,000.00

Start Date: February 15, 2008
End Date: July 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Lantibiotic Synthesis Using Differentially Protected Orthogonal Lanthionines

The Small Business Innovation Research (SBIR) Phase II project aims to develop differentially protected orthogonal lanthionine technology (DPLOT) to synthesize novel antibiotics. Lanthionines are found in nature and have been isolated from a variety of sources. Although amino acids, lanthionines are not components of proteins. They are however, constituents of a group of naturally occurring peptide antibiotics called lantibiotics, which includes nisin (a food preservative), subtilin, epidermin (an anti staphylococcus and streptococcus agent), and ancovenin (an enzyme inhibitor). Due to their mechanism of action, resistance to lantibiotics is uncommon and as such they can be of value for treating antibiotic resistant bacterial infections.

The technology under development would allow the synthesis of novel lantibiotics that may be effective against the growing number of antibiotic resistant bacteria and would expand the therapeutic arsenal available for treating such infections. It would therefore have a profound impact on public health and the control of infectious diseases caused by bacteria.

Parabon NanoLabs, Inc.

Phase II Award No.: 1026606

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Nano-scale Engineering via Grid-scale Computing: Designing, Optimizing and Manufacturing Cancer Therapeutics

This Small Business Innovation Research (SBIR) Phase II project will advance the development of new drug compounds for the treatment of glioma, which have been designed and constructed with an innovative combination of grid-powered, computer-aided design (CAD) software and DNA nano-fabrication technology. The compounds are self-assembling DNA nanostructures functionalized with molecular subcomponents for targeting and destroying malignant glioma (brain) tumors. Prognosis for glioma is poor because complete surgical resection is impossible and chemotherapy (being poorly selective) leads to collateral brain damage, hence treatments are needed that target and destroy glioma cells with high specificity.

The broader impacts of this research are the societal benefits associated with improved disease outcomes through the creation of revolutionary new nano-pharmaceuticals. The Company's efforts under this project are focused initially on creating an effective treatment for glioma, but the Company's Essemblix platform has the potential to be used to create compounds for a wide variety of indications. The ability to "plug and play" at the molecular level, made possible by PNL's computational and nano-fabrication technology, opens the door to the deliberate design and development of entirely new types of pharmaceutical materials that could address indications across a vast and diverse number of pharmaceutical and biotechnology market segments.

Parallel Synthesis Technologies, Inc

Phase II Award No.: 0924672

Award Amount: $488,326.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Hybridization and SNP Detection Using Unlabeled Target DNA

This award is funded under the American Recovery and Reinvestment Act of 2009 Public Law 111-5). This SBIR Phase II project will provide technology to perform remote nucleic acid testing (NAT) in any location. The combination of (a) our Probe-Target-Reporter (PTR) assay which allows the detection of unlabeled Target DNA, (b) our Parallume optical encoding technology which provides the ability to multiplex a large number of samples in each assay and (c) an inexpensive, battery-powered imaging system, based on a $500 commercial CMOS that is completely portable, will be used to build an autonomous NAT platform. This system will be used to detect and defend against the imminent invasion of California's citrus crop by the Liberibacter pathogen and its insect vector/host which causes the 100% fatal and incurable Citrus Greening disease of citrus. Collaborator Isca Technologies will provide a "Front End" instrument which can selectively identify an insect by measuring its wing beat frequency as it flies through a laser curtain. This selective insect trap will provide a filtered homogenate of primarily the desired insect vector and pathogen which will be analyzed with our PTR in the field. The data will be relayed to a central database which can provide a real time assessment of the location and bacterial load of the insect vector.

The Nucleic Acid Testing (NAT) technology under development as part of this project represents a substantial advance in the ability to perform assays outside of the traditional laboratory or clinical setting. This technology can be used to detect Target DNA sequences without the need to chemically label the sample thereby allowing the NAT analysis to be performed in any location. This NAT technology can be combined with our Parallume optical encoding technology which allows many sample to be measured simultaneously. The ability to analyze many DNA simultaneously without access to a laboratory on a completely portable system will allow NAT to be performed in Low Resource Settings or for Agricultural applications around the world.

Phoenix Biosystems

Phase II Award No.: 1026459

Award Amount: $450,495.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Label Free Nucleic Acid Assays for POC Diagnostics

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a for point-of-care (POC) nucleic acid assay for STD (sexually transmitted diseases) diagnostics using Electrochemical Impedance Spectroscopy (EIS). Chlamydia trachomatis (CT) and Neisseria gonorrhoeae (GC) infections are two of the most common sexually transmitted diseases worldwide. The company proposes to develop a multiplex assay and testing platform for the direct detection of CT and GC rRNA using EIS-based assays and a sensor array. In a final product for clinical settings, collected sample (e.g., swab or urine) will be processed on-cartridge, with all cartridges provided in a sealed, RNase-free package.

The broader impact/commercial potential of this project will address the unmet market needs for a rapid and cost-effective nucleic acid based POC system to diagnose individuals with infectious disease-causing agents or toxins in nontraditional health care settings. Often persons who present to a clinic for STD testing never return to the clinic to receive their STD test result. Thus, the availability of a POC test that can immediately provide results at the clinic is highly desirable. Current POC tests lack sensitivity, which may lead to high false negative as well as false positive results. The company proposes to develop an inexpensive, highly sensitive, easy-to-use POC STD device to address this compelling market need. In addition, the EIS-based biosensor system could be adapted for the POC detection of other infectious diseases.

PHYSCIENT, INC.

Phase II Award No.: 1026703

Award Amount: $499,986.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Detection and Prevention of Tissue Trauma During Surgical Retraction

This Small Business Innovation Research Phase II project will develop a hand-held controller for motor-powered surgical instruments. The controller will enable automated operation of the surgical instrument, including biomechanically informed algorithms, that decrease trauma to tissues during surgery. This controller will be first deployed on a new thoracic retractor, an instrument used to pry apart the rigid tissues of the chest to provide surgical access to organs inside the chest, e.g. the heart and lungs. Thoracic retractors are used in two common thoracic procedures for surgical access: (1) thoracotomy, in which an incision is made between the ribs and the thoracic retractor pries apart the ribs, and (2) sternotomy, in which the sternum is bisected and the thoracic retractor pries apart the two halves of the thoracic cage. Current thoracic retractors are simple mechanical jacks developed in the 1930's, and they severely traumatize the tissues of the chest by, for example, breaking ribs and tearing ligaments. The controller developed in this SBIR will enable automated retraction of the thoracic tissues, including an algorithm that can both detect that a fracture is about to occur and then avert that fracture, thereby greatly decreasing trauma to the thoracic tissues.

The broader impact/commercial potential of this project is both to improve patient's lives by decreasing the trauma of surgery (decreasing both post-surgical pain and complications) and to decrease the cost of health care by reducing the amount of medical care a patient needs after surgery (both decreasing the length of hospital stays after surgery and reducing the incidence of expensive complications). Nearly 600,000 people have a sternotomy or a thoracotomy each year in the US, and recovery from these procedures is frequently marked by significant post-operative respiratory dysfunction and pain. The new surgical instrument controller being developed in this project will improve post-surgical recovery for all of these patients. Importantly, this is the first application of biomechanically-informed algorithms to surgical retraction, and we anticipate their applicability to many more surgical procedures, generating both significant commercial opportunity and significant improvements in health care.

Piezo Resonance Innovations, Inc.

Phase II Award No.: 0923861

Award Amount: $638,000.00

Start Date: August 15, 2009
End Date: January 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Active Device for Reliable Cleaning of Feeding Tubes

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will continue development of the Tube-Clear(TM) device to clear clogged and sluggish feeding tubes, satisfying a critical medical need and reaching a viable commercial market. When compromised patients are unable to swallow food or medication, feeding tubes are used to administer medication and nutrition. A clog leaves the patient without medication or nutrition for hours, or even days, and is extremely frustrating to both patient and caregiver. Approximately 410,000 PEG (long-term) tubes and 5 million NG (short-term) tubes are placed each year in the U.S. Each type of tube presents specific challenges for feeding, clogging and cleaning. The Tube-Clear(TM) PEG prototype cleaned a clog of food and ground medication, in less than one minute, that could not be easily removed using any other available approach. Demonstration of the PEG alpha-prototype at four focus groups, for over 20 nurses from a variety of clinical settings, produced an overwhelmingly positive response toward the device. Phase II (following on Phase IB) will further develop both the PEG tube and NG tube cleaners to beta-prototypes, take the devices through clinical trials, and establish manufacturing protocols, all under a Food and Drug Administration compliant quality system. The Tube-Clear will ease the burden on nursing staff and patients dealing with the frustration of clogged and sluggish feeding tubes.

A structured financial and technical plan has been put in place using a combination of funds from SBIR (Phase I, IB, II and IIB), the State of Pennsylvania, Commercial Partners, and equity investment to reach specific milestones over a 2.5 year period. The NSF Phase I project kicked off this development effort with a highly successfully Alpha prototype for PEG tubes, which was tested in a series of nursing focus groups, resulting in extremely positive reviews. The Tube-Clear for PEG cleaning has an anticipated market launch date in 2010, followed by a NG tube cleaning device market launch in 2011. By 2013, Piezo Resonance Innovations (PRII) anticipates revenue for the Tube-Clear (TM) of $25-50 Million. Three commercial partners, with presence in the enteral feeding market, have indicated strong interest in the device and would provide access to their paths to market, marketing staff, and device development expertise. They have also expressed willingness to contribute financially, potentially as Phase IIB partners. PRII staff will also teach guest lectures on medical device design in the Penn State School of Nursing.

Plant Sensory Systems, LLC.

Phase II Award No.: 0923966

Award Amount: $615,999.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Anthony Walters

Sector: Biological and Medical Technologies

SBIR Phase II: GABA-Mediated Nitrogen Efficiency

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project addresses the need for crops with increased yield. Yield is directly related to nitrogen (N) utilization and is dramatically affected by climate. Plant Sensory Systems has developed a genetic modification to plants that increases their N use efficiency (NUE) and tolerance to drought and high temperatures. The modification is the insertion of a novel pathway for making gamma-aminobutyric acid (GABA) in plants. Phase I research demonstrated that the genetically modified model plants were more drought- and heat tolerant and had higher yield in both N-limited and N-sufficient conditions compared to wildtype plants. In Phase II the gene construct will be tested in a crop plant to demonstrate commercial feasibility. Agronomic performance in N- and water-limited and sufficient conditions will be determined in homozygote corn lines.

The broader impacts of this research are the stabilization of the agronomic sector of the economy and a reduction in adverse effects of agriculture on the environment. The innovation would lead to crops with higher yields that cost less to produce. The need for less N fertilizer would reduce costs to the growers and have significant environmental savings by reducing the amount of N that runs into the watershed. Moreover, a reduction in fertilizer production and application would reduce greenhouse gas emissions. The innovation confers tolerance to climate changes, which would also reduce crop-production costs and increase yield. The proposed technology has great commercial potential in a market actively seeking increased NUE and value-added traits.

Prediction Sciences, LLC

Phase II Award No.: 0750452
Phase IIB Award No.: 1063214

Award Amount: $847,480.00

Start Date: June 1, 2008
End Date: November 30, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Multi-Marker Prognostic Test for Breast Cancer Outcome

This Small Business Innovation Research (SBIR) Phase II project aims to continue the validation of a set of markers for predicting recurrence and guiding the selection of treatment in stage I-III breast cancer patients. Upon removal of their primary stage I-III operable tumors, breast cancer patients must decide whether or not to receive adjuvant therapy such as chemotherapy, or hormone therapy. Currently, the physician and patient can arrive at the decision by relying on several published guidelines whose accuracy is limited by the fact that they are based on general clinicopathologic data such as tumor size and grade. Thus the majority of patients are recommended to receive adjuvant therapy, although only a small fraction of them benefit from it.

Availability of a set of reliable markers that can predict recurrence of tumors would allow tailoring of adjuvant therapy for each patient and is thus likely to reduce the chances of under-treatment and over-treatment. As such, it would be of great benefit to cancer patients, as well as to oncologists.

Real-Time Analyzers, Inc.

Phase II Award No.: 0956170

Award Amount: $501,904.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: A Label-Free Surface-enhanced Raman Spectroscopy-Capture Assay in Microchips for Biological Warfare Agents

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype analyzer that can detect, identify, and quantify the presence of Category A (B and C) bioagents at the required specificity and sensitivity (e.g. in air 104 spores/m3, 100 organisms/m3 and 2-300 mg toxin/m3) within 10 minutes. The analyzers will incorporate a novel surface-enhanced Raman spectroscopy (SERS)-based assay into sample systems read by a portable Raman spectrometer. The assays will be functionalized to selectively capture specific bioagents and generate unique SER spectra when irradiated by the analyzer laser. During Phase I, feasibility was demonstrated by selectively binding and detecting 25 ppm B. cereus (a B. anthracis surrogate) in the presence of 250 ppm B. subtilis. During Phase II, the assays will be developed to detect several real agents, such as B. anthracis (anthrax), Yersinia pestis (Plague), Francisella tularensis (Tularemia), and Clostridium botulinum (Botulism). The assays will then be incorporated into a product prototype that autonomously detects aerosolized bioagents. The analytical capabilities of the prototype will be validated at the US Army's Edgewood Chemical Biological Center.

The broader/commercial impact of this project will provide a bioagent detector with the necessary sensitivity and speed to save lives and reduce substantially the terror associated with biological attacks. The continued presence of US military personnel in the Middle East has produced a persistent fear that biological warfare agents may be used by terrorists against civilian and military personnel at home and abroad. The proposed analyzer will allow measurement of such bioagents within 10 minutes, a vast improvement over the 2-3 hours required by current technology. Initially, the proposed detector will be used to protect military bases. Once established, the application of this product will be expanded to civilian applications, such as transit systems, high profile buildings (federal, financial, Fortune 500), stadiums, airports, and malls. The US military and civilian market is currently estimated at $0.5 Billion.

Semprus Bioscience Corporation

Phase II Award No.: 0822959
Phase IIB Award No.: 1047700

Award Amount: $999,923.00

Start Date: August 15, 2008
End Date: July 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Permanent Attachment of Antimicrobial Peptides to Central Venous Catheters.

This Small Business Innovation Research (SBIR) Phase II project continues SteriCoat's development of a permanent antimicrobial coating for use on central venous catheters. Current leaching antimicrobial technology does not possess the duration of efficacy required to protect these devices over the lifetime of implantation, especially for peripherally inserted central lines (PICCs). Research during this Phase II project will focus on the integration of proprietary polymer technology with tethered antimicrobial peptide (AmP) technology developed in Phase I to maximize the efficacy and bioavailability of the immobilized AmPs in vivo. Work will also be performed to ensure the manufacturability of SteriCoat's coating technology, including prototype production. After transitioning this formulation to the intra- and extraluminal surfaces of a polyurethane tube, efficacy and biocompatibility will be demonstrated both in vitro and in vivo. By the end of this Phase II project, SteriCoat will have an antimicrobial CVC model with efficacy proven in vivo using the models designed by industry thought leaders and will be ready for scale-up and manufacturing.

This SBIR Phase II project addresses the hospital infections afflicting 1.7 million patients and killing 99,000 in the US annually, the majority of which are associated with medical devices. Existing slow-release antimicrobial coatings are insufficient in addressing device infection. They have a limited lifespan and concerns over drug resistance and toxicity because the drug gets distributed in the bloodstream. SteriCoat is developing a permanent coating using antimicrobial peptides (AmPs) to prevent bacterial colonization of central venous catheters (CVCs), a $350M market. The goal of this project is to deliver a polyurethane-based antimicrobial CVC model which incorporates a surface functionalization with AmPs and to test the ability of this approach in resisting bacterial colonization. By the end of this phase II project, SteriCoat will have verified in vivo efficacy of prototype catheters and be positioned to begin GLP studies for FDA product approval. In addition, achievement of the technical objectives of this Phase II will open up avenues for additional investigation in the field of bioactive ligand presentation as the developed technology could lend to the efficacy of many biomaterial applications in addition to antimicrobials.

SFC Fluidics, Inc.

Phase II Award No.: 0822723
Phase IIB Award No.: 1049460

Award Amount: $573,136.00

Start Date: August 1, 2008
End Date: July 31, 2011

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

STTR Phase II: Magnetohydrodynamic-based Circular Liquid Chromatography

This STTR Phase II research project develops a circular chemical separation system on a small (~1 inch x 1 inch) chip. This chip and the associated instrument will separate complex mixtures for biological, chemical, medical, and industrial applications. Based on magnetohydrodynamic (MHD)-driven liquid flow, liquid chromatographic (LC) separations will be accomplished in a circular, closed-loop format. Typically, LC separations require a sample containing multiple analytes to flow in a single direction along a fixed-length, linear column with detection performed after the analytes elute from the column. In the circular LC system, miniaturization is possible because samples are instead circulated around a closed-loop chromatographic column thus, the effective column length is not limited to small chip dimensions. Very few methods can provide the mobile-phase pumping in a closed-loop that is required for practical application of circular LC. The MHD-based circular LC system envisioned will be small, portable, and designed for laboratory as well as field use. The sealed LC chip will contain the stationary phase, mobile phase, and all in situ MHD pumps needed to conduct the separation of complex samples. This prototype LC instrument will be designed and fabricated with a built-in fluorescence detector for monitoring analyte separation directly on the chromatographic column.

The broader impacts of this research are highlighted by the ability of the proposed circular separation system to miniaturize a valuable analytical tool, liquid chromatography (LC). Samples of interest include human blood serum, saliva, and urine, with component analytes of interest that are equally diverse (e.g. proteins, pharmaceuticals, and small molecular biomarkers). Many analytes in these complex mixtures have similar properties and cannot be separated and analyzed using a very short chromatographic column, which has limited the miniaturization of this important analytical tool. This limitation is overcome using circular LC, where the effective column length is not limited by the small chip sizes that are essential for portable LC instrumentation. SFC Fluidics' core technology makes possible the miniaturized, closed-loop pumping required for implementation. This method has broad implications for the portable LC systems for field deployment or point-of-care applications. The market opportunity is expected to be significant, particularly when considering that applicability extends beyond the traditional instrumentation market into the worldwide point-of-care diagnostics market.

Solidus Biosciences, Inc.

Phase II Award No.: 0923853

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

STTR Phase II: Development of a Lead Optimization Chip for Drug Discovery

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project will address further development and commercialization of a multi-enzyme lead optimization chip (Multizyme Chip) for high-throughput generation of lead compound analogs coupled with cell-based screening for the rapid identification of biologically active derivatives. Such a capability directly impacts a key bottleneck in drug discovery; namely, the efficient optimization of lead compounds to develop drugs with optimal pharmacological properties. Solidus Biosciences, Inc. proposes to combine six biocatalysis with pharmacological screening to provide rapid identification of biologically active compounds against cell-specific targets, which is a new paradigm for lead optimization. Moreover, the Multizyme Chip platform will be well-suited for lead optimization in related industries, including agrochemicals, cosmetics, and cosmeceuticals. The Solidus technology will thus improve the competitiveness and efficiency of the pharmaceutical, cosmetics, and chemical industries, and will serve as a rich source of new and improved commercial products.

The broader impacts of this research are the advances that Solidus Biosciences will achieve toward generating better and safer drugs, reducing the cost to develop these drugs, and increasing the overall efficiency of the pharmaceutical industry. Solidus will generate Multizyme Chips for purchase by pharmaceutical and biotechnology companies to facilitate their lead optimization programs, particularly those involving natural product-derived and complex synthetic small molecule leads. Cryopreservation techniques developed in Phase II will enable the sale of chips and chip-handling devices produced during Phase I, and will allow seamless penetration of the Solidus technology platform into the company's target markets.

Stemina Biomarker Discovery, Inc.

Phase II Award No.: 1058355

Award Amount: $500,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: Metabolomics of Human Embryonic Stem Cells to Predict Teratogenicity: An Alternative Developmental Toxicity Model

This Small Business Innovation Research (SBIR) Phase II project will fund a continuation of breakthrough research, development and commercialization of an in vitro assay to help prevent birth defects. This innovative product is driven by a need to create a test for human developmental toxicity that is more accurate than current tests that use animals. False negative results from these animal assays have lead to unexpected cases of birth defects, such as observed with Thalidomide. This assay, performed on human embryonic stem cells, is more predictive of developmental toxicity than animal models (80% vs 60%) and unlike animal models, provides data about specific human biochemical pathways that are affected. This will fund research to 1) identify biomarkers of developmental toxicity present in three different human cell lines, 2) optimize automation systems, 3) create a web-based interface to be used by customers, 4) standardize and create quality control procedures and 5) take the initial steps required for validation of the assay by the European Centre for the Validation of Alternative Methods (ECVAM). Upon validation, the test will be required in Europe for assessing developmental toxicity of newly developed pharmaceuticals and may be further used for testing of environmental chemicals as well.

The broader impacts of this research include 1) a global reduction in drug and chemical induced human birth defects 2) significant cost savings (up to $70 million per drug) for pharmaceutical companies allowing greater confidence in drug candidate selection and 3) a major global reduction in animal testing.

Sterling Biomedical, LLC

Phase II Award No.: 1058279

Award Amount: $418,443.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: A Novel Antimicrobial Polymer for Medical Devices

This Small Business Innovation Research (SBIR) Phase II project aims to develop an antimicrobial polymer technology with silver compounded into the catheter matrix, which allows for antimicrobial action expected to last several months. This cost-effective antimicrobial polymer technology prevents the formation of surface biofilms on long-term implantable devices, without generating bacterial resistance. The root cause of these infections is the bacterial colonization of the catheter, with the likelihood of infection increasing as a function of catheter implantation time. Currently, there are no low-cost, long-term antimicrobial catheters, thus the proposed technology would fill a much needed clinical demand.

The broader/commercial impact of this project addresses the 280,000 catheter-related bloodstream infections in the U.S. that cost over $3 billion per year in excess healthcare costs, claiming 80,000 deaths. The proposed technology will help clinicians attain and sustain zero indwelling catheter bloodstream infections. The $1.2 billion implantable device market urgently needs inherently antimicrobial catheters, thus obviating the need for systemic antibiotic treatment. Since no expensive coating procedures have to be performed, it will lead to cost effective manufacturing. This should lead to rapid commercialization of a family of antimicrobial catheters, especially since these advanced catheters will significantly help to reduce outcome costs.

STRATATECH CORPORATION

Phase II Award No.: 1058591

Award Amount: $499,877.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Gregory T. Baxter

Sector: Biological and Medical Technologies

SBIR Phase II: An Innovative Full-Thickness Human Skin Model for Increased Throughput Screening in Drug Discovery

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a high-throughput assay incorporating 3-D skin models capable of accurately identifying and characterizing DNA damage. There is an urgent need for improved genotoxicity assays for safety screening in drug development. The process by which drug compounds are usually screened is expensive, time-consuming, and often does not provide an accurate depiction of in vivo behavior. Phase I of this project developed a full-thickness skin model that can be used in a range of toxicological assays. Phase II will address the limitations of current genotoxicity assays by incorporating fluorescent reporter constructs into the 96-well skin model to create an assay that is high-throughput and accurately distinguishes between classes of genotoxins.

The broader impacts of this research are to develop a genotoxicity screen that is more informative, accurate, and high-throughput than existing alternatives. Development of accurate in vitro assays not only reduces the need for animal testing, but can also reduce the risk to patients included in clinical trials by providing better predictions of the human response. Toxicity has become one of the leading reasons for product failure during drug development. The ability for this assay to identify and eliminate harmful compounds earlier in the development process could significantly reduce the costs and accelerate the timeline of drug development. In addition to these direct contributions for drug and chemical screening, the mechanistic data provided by this assay will provide a valuable tool for basic science research into DNA damage.

STREAMLINE AUTOMATION, LLC

Phase II Award No.: 1026265

Award Amount: $499,853.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Particle Filtering Technology for Wearable Medical Sensors

This Small Business Innovation Research (SBIR) Phase II project will develop an enhanced pulse oximeter prototype ready for external demonstration. The key innovation of the prototype will be the Intelligent Data Extraction Algorithm (IDEA), which during Phase I demonstrated extraction of embedded hemodynamic information from photoplethysmograms, including left-ventricular stroke volume and cardiac output. IDEA will evolve in sophistication to increase diagnostic range and accuracy. Both extended evaluation and preliminary clinical validation studies will take place in order to assess the reliability of measured hemodynamic values and trends. Close interaction with doctors will help define clinical uses for this new technology. If successful, the final prototype will enable the noninvasive measurement of valuable hemodynamics with associated error bars (confidence intervals) including stroke volume and cardiac output. Other features include resistance to strong motion artifacts, continuous and real-time operation, and utilization of existing sensor hardware.

The broader impact/commercial potential of this project is to solve noninvasive measurement of valuable hemodynamics that cannot be met with current technology. During anesthesia, surgery, and recovery, our IDEA-enhanced pulse oximeter can track the patient's hemodynamic evolution throughout, warning against possible adverse reactions or 'silent hemorrhages' that do not show up in any standard monitoring equipment. In the neonatal ward, it can monitor babies born with congenital heart disease or poor blood flow. At home, it can be used to monitor patients with chronic heart conditions (the top killer in the US) and warn doctors about developing acute problems such as arrhythmias and heart attacks. In the battlefield and disaster areas, our device can dramatically improve the speed and accuracy of triage to save the lives of injured soldiers and victims. Many other medical practices would benefit from the use of noninvasive and continuous stroke volume and other hemodynamic monitoring to expand the amount of vital information available at the patient care area and eliminate the need for risky invasive procedures.

SYNTHEZYME LLC

Phase II Award No.: 1058511

Award Amount: $475,766.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Program Director: Anthony Walters

Sector: Biological and Medical Technologies

SBIR Phase II: Advanced Biopesticides from Yeast Produced Sophorolipids and Modified Analogs

This Small Business Innovation Research (SBIR) Phase II project will address further development of findings from the Phase I Project addressing development of advanced biopesticides by simple and scalable modification of sophorolipids. The yeast Candida bombicola produces sophorolipids (SLs) in volumetric yields of ~ 300 g/L. The Phase I program demonstrated that by simple chemical modification of unrefined natural SLs, a series of five highly active lead compounds were identified which possess broad spectrum activity against all three major fungal groups that cause serious diseases in commercially important plants. By amidation of the SL fatty acid carboxyl group (e.g. - NH2CH2CH2N(CH3)2), or by reduction of the SL-fatty acid double bond, derivative activity against pathogens greatly increased. Minimum inhibitory concentration (MIC) values of amide SL-derivatives were generally on a par with tested commercial fungicides.

Broader Impacts/Commercial Potential: The broader impacts of this research address the market pull for green agricultural products by developing a bio-pesticide produced via an efficient microbial fermentation followed by simple chemical modification to improve the performance of nature's molecules. The goal is to create a superior bio-pesticide product that does not harm the environment, is safe for farmers that regularly handle these materials, and to provide safe food for consumers. SyntheZyme bio-pesticides will contribute to the on-going green food-production revolution. Their introduction into the market is expected to replace an increasing fraction of synthetic chemical pesticides during season-long disease control programs. Furthermore, new safe bio-pesticides are needed to replace chemical pesticides now banned due to tightened regulations and increased concerns about their pollution and health hazards.

TransMembrane Biosciences

Phase II Award No.: 0956852

Award Amount: $528,000.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Development of a Eukaryotic Membrane Protein Overexpression System

This Small Business Innovation Research (SBIR) Phase II project concentrates on creating a novel, economical and powerful production technology for eukaryotic membrane proteins, a group of proteins that remain intractable yet are of tremendous medical and scientific importance. A majority of membrane proteins are very difficult to obtain in any significant quantities, even at milligrams scale since their natural biosynthesis levels often are very low and currently available production methods are not effective for membrane proteins. This research project will utilize a versatile and easy-to-cultivate microorganism that can generate proliferated membranes under certain conditions to host the recombinant membrane proteins. The efficiency of various strategies will be evaluated through activity assays and direct protein isolation.

The broader impact of the technology are new generations of efficacious medicines in virtually all therapeutic areas including infectious diseases, cancer, genetic diseases due to genetic defect in membrane proteins, central nervous system diseases, cardiovascular system diseases, digestive system diseases and many others. The impact of this technology in science, in medicine and in society will be very significant. The technology can be utilized to mass-produce a very large number of membrane proteins, especially surface membrane proteins for applications in structure-based drug design, in protein engineering, in protein therapeutics, and for the development of diagnostics and vaccines against infectious diseases and cancer. These efforts will not only provide new scientific understandings of very difficult-to-study membrane proteins but also eventually transform the current landscape of diagnostics and therapeutics for human diseases and illnesses.

Wasatch Microfluidics, LLC

Phase II Award No.: 0924012

Award Amount: $495,089.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: A Higher Throughput SPR Biosensor

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will develop a 48 channel surface plasmon resonance (SPR) instrument and demonstrate a high throughput flow cell array for use with a variety of label-free biosensing platforms. Flow cell technology is currently the limiting factor in the development of high throughput label-free sensing technologies. Modification of Wasatch Microfluidics Continuous Flow MicrospotterTM into a highly parallel flow cell should begin to eliminate this bottleneck and provide a template for even more highly parallel systems. We will develop an understanding of how the proposed flow cell technology will impact the sensing capabilities of a commercial-ready surface plasmon resonance (SPR) instrument and an optimized baseline protocols will be developed. The end result will be a 48 channel flow cell, which will be scalable to much higher throughputs (192, 1536). This flow cell will be flexible such that it will be easily integrated with a variety of label-free sensing technologies. The end result of this research and development effort will be an SPR instrument with approximately 10 times the capacity of the best current systems and will lay the ground work for much higher density systems.

The broader impacts of this technology include the commercial opportunities of the Microfluidic Flow Cell Array (MFCA). The MFCA will be developed for integration with the biosensing platforms of a number of other companies. Specifically we will target label-free technologies used to measure kinetic and affinity constants for binding of molecules to one another. This is currently a $100M/year market. From our discussions with pharmaceutical companies, higher throughput label-free systems will lead to much larger implementation of these technologies and a significant commercial potential, including a larger market opportunity. Even the most basic implementation of our flow cell will have a substantial impact. Currently, it takes the flagship Biacore (GE) instrument up to 28 hrs to process 384 samples. These same 384 samples would only take 1 hr with our proposed combined MFCA / SPR instrument utilizing our CFM technology. These same instruments will then lead to substantially faster and more effective drug discovery processes, and eventually better health for the US population.

Zymera Corporation

Phase II Award No.: 0956764

Award Amount: $600,296.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Bioluminescence Resonance Energy Transfer Probes for Molecular Imaging

This Small Business Innovation Research (SBIR) Phase II project will demonstrate the production of robust, versatile probes based on Bioluminescence Resonance Energy Transfer to Quantum Dots (BRET-Qdot®) technology. The main goal of this project is to develop a platform for target-directed in vivo imaging of tissue, such as whole tumors and organs, in animal models. To accomplish this goal, biotinylated targeting agents for the detection of important biomarkers, in combination with BRET-Qdot® probes with streptavidin functionality, will be developed to provide one-step target detection. The probes will represent the range of molecular sizes used for a majority of assays, from small molecules to antibodies, thus enabling detection of virtually any cell surface target molecule.

The broader impact/commercial potential of this project is the development of a sensitive probe reagent that will be broadly applicable to a wide range of preclinical assays including in vivo imaging of tumors, organs and various anatomical structures. In order to understand the molecular mechanisms underlying diseases, such as cancer, autoimmune diseases, and other diseases, there is increasing interest in advancing from cell-based assays to in vivo imaging of disease states in small animal models. The targeted BRET-Qdot® platform will provide a cost effective,convenient and effective alternative to competing fluorescence and bioluminescence imaging probe technology.

3 H Company

Phase II Award No.: 0956759

Award Amount: $499,998.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Split Amine Absorbent for CO2 Capture from Post Combustion Flue Gas of Coal Fired Power Plants

This Small Business Innovation Research (SBIR) Phase II project is designed to demonstrate a novel low cost and low energy-consuming CO2 capture technology. The success of CO2 capture and sequestration rely on the development of cost-effective and low energy-consuming CO2 separation system. The process, called Split Amine Absorption, is able to significantly reduce the CO2 capture cost. The Phase II objective is to evaluate the technical and economic viability of the technology for the CO2 capture from flue gas of post combustion coal fired power plants. The approach is to: 1) test previously developed bench-scale models and 2) design and install a prototype pilot scale system and operate, test, collect data, and optimize its performance. The system will be installed as a slipstream unit in an existing coal fired power plant. It will be designed to achieve at least 90% CO2 removal efficiency. The data collected will be used to evaluate the technical and economic viability of the technology.

The broader impact/commercial potential of this project is significant cost savings for the reduction of CO2 emissions from coal-fired power plants. In comparison with today's state-of-art monoethanolamine (MEA) technology, the proposed technology is able to reduce the cost of CO2 capture by 85%. Reducing this cost is the key to making coal an economically viable and socially acceptable fuel for generating electricity.

ADA Technologies, Inc.

Phase II Award No.: 0924197

Award Amount: $515,831.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Anthony Walters

Sector: Chemical Technologies

STTR Phase II: Advanced Lithium-ion Nanobatteries

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project proposes to develop nanotechnology-enabled advanced lithium-ion batteries for electric transportation applications. While lithium-ion batteries represent the current state-of-the-art for rechargeable batteries, performance of current lithium-ion battery designs is limited by the properties of both electrodes and electrolytes. The proposed research combines nanostructured electrodes with environmentally benign electrolytes to develop high-performance, safe, and long lifespan lithium-ion batteries. The proposed research will optimize nanostructured electrodes, produce the electrodes in large scale, and fabricate and evaluate packaged prototype batteries. A team capable of fabricating, evaluating, and commercializing these batteries for electric transportation applications has been assembled.

The broader impact of this research is to improve the functionality and marketability of advanced electric transportation applications such as hybrid electric vehicles (HEVs), Plug-In Hybrid Electric Vehicles (PHEVs), and Electric Vehicles (EVs). The proposed batteries will significantly benefit electric vehicle applications by decreasing harmful emissions, achieving better fuel economy, and reducing our nation's reliance on foreign petroleum sources. More broadly, they will also benefit a wide range of applications including consumer electronics, medical electronics, electric utility industries, and military and defense systems. The technology under development in this project will enable the next generation of lithium-ion batteries that will offer superior performance and reduced environmental concerns. In addition to lithium-ion batteries, nanostructured materials demonstrated in this project will have a broad impact on other electronic and electrochemical devices.

Advanced Materials and Processes

Phase II Award No.: 0924122

Award Amount: $461,786.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Chemical Technologies

STTR Phase II: Ultra-High Efficiency Biodiesel Manufacturing

This STTR Phase II project will change the paradigm that two-phase chemical reactions must use mechanical mixing to be commercially effective. The innovative Fiber Reactor (TM) offers two orders of magnitude change in efficiency for chemical and biochemical manufacturing. This project will focus on biodiesel transesterification reactions. Biodiesel plants convert fats/oils to biodiesel with multiple reactor stages and centrifuge stages. Complexity is due to poor mass transfer, poor reaction conversion, and poor phase separations due to by-product soap. Improving mass transfer and eliminating soap dispersions will reduce the cost of manufacturing biodiesel. In Phase I experiments, the Fiber Reactor was 3-100 times faster than commercial biodiesel processes with superior conversion. Advanced Materials and Processes has found an unconventional way to improve mass transfer and simultaneously solve phase separation problems in biodiesel processes. Use of a Fiber Reactor will reduce complexity, size, capital, energy consumption, and water pollution by dramatically improving mass transfer and eliminating dispersions.

Phase I proved feasibility of energy savings and process intensification in biodiesel manufacturing. Phase II will use Phase I models and CHEMCAD models to design and operate a pilot reactor using the high throughput continuous static Fiber Reactor and wash processes. Biodiesel capacity could increase 10 times by 2015 and improve U.S. energy security. Two hurdles remain - produce the triglyceride needed and match petroleum economics. A new industry and networks are being developed to supply enough algae oil. Fiber Reactors will reduce capital and operating cost for producing biodiesel by 50% and use low cost crude oils/fats. Phase I developed basic transesterification chemistry for Fiber Reactors. Phase II will develop chemistry/engineering data for scale up. Fiber technology will apply to pharmaceutical and specialty chemical manufacturing with similar benefits. This project will integrate research and education by training students in organic chemistry, fibers, materials, processes, pilot operations, fractionation, analysis, organic synthesis, and quality control. Students use wet chemistry, GPC, HPLC and LC/MS for identification/quantification of raw materials and reaction products. Texas State University graduated 46 chemistry/ biochemistry majors in 2008. Enrollment in 2009 included 329 chemistry/biochemistry majors. The 37 graduate students were 35% minority and 48% women. IEIS has provided research assistantships/ employment to over 100 students of whom 62% were women or minorities. This project will have a positive impact on the research capabilities of academic departments and IEIS; and help women and minorities to improve their training in industrial chemistry.

AGILTRON INCORPORATED

Phase II Award No.: 1058570

Award Amount: $487,872.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Anthony Walters

Sector: Chemical Technologies

SBIR Phase II: High Performance Supercapacitors Based on Nano-engineered Electrodes

Intellectual Merit: Supercapacitors are indispensable energy storage and conversion devices with wide applications. Agiltron is developing a next generation EDLC supercapacitor that has more than two times the energy density and ten times the power density of the best conventional carbon-based supercapacitors. In Phase I we successfully fabricated the novel TiC/TiC-CDC core/shell nanostructure electrode, demonstrating the predicted 2X energy density in a test device. We then calculated the power density, predicting a 10X improvement over conventional supercapacitors. This combination of high energy density and high power density has not been attained before. In Phase II, we plan to produce supercapacitor prototypes, and optimize, standardize, and scale up the material fabrication process, including the investigation of roll-to-roll manufacturing of the proposed supercapacitor electrodes. At the end of Phase II we will have developed a prototype process capable of commercializing these high performance supercapacitors.

Broader Impact: Supercapacitors are indispensable energy storage devices because their performance bridges those of batteries and conventional capacitors. The most significant challenges for supercapacitors are to increase their energy density and power density. Our proposed core/shell nanostructured supercapacitors address these two challenges simultaneously. The proposed superior supercapacitors will meet the needs of quickly growing markets of hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEVs), city buses, rails (heavy rail vehicles, tramways and metro), and renewable energy systems (wind power and solar power) to satisfy the peak power needs in a cost-effective manner that battery cannot provide. Other potential domestic applications include UPS systems, cell phones, PDAs, medical devices, AMRs, notebooks, communication equipment, sensors, actuators, car audio components, welding machines, solar lighting, inverters, cameras, copy machines, and power supplies. Core/shell nanostructured materials offer the potential to provide multifunctional application in supercapacitors, solar cells, and batteries. The success of this program will stimulate enthusiastic academic and industrial interests for using core/shell nanostructured materials to address significant energy problems, and thus open new horizons that have not been imagined before.

ATRP Solutions, Inc.

Phase II Award No.: 1026575

Award Amount: $520,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Program Director: Anthony Walters

Sector: Chemical Technologies

SBIR Phase II: Adapting ATRP to Industrial Scale Production

This Small Business Innovation Research (SBIR) Phase II project will scale up the atom transfer radical polymerization (ATRP) synthetic method to a 200 L scale from a 1 L scale that was developed in the Phase I work. This ATRP synthetic process is a highly controlled method for synthesizing polymers and copolymers specifically with highly tailored architectures including molecular structure and molecular weight distribution which can affect the properties of the material significantly.

The broader impact/commercial potential of the project will be to create a commercially viable option for producing specialty polymers that might not otherwise be feasible to produce on a large scale. This SBIR Phase II project will allow straightforward scale-up of ATRP process and bring it much closer to the broad market of commercial products. More importantly, the successful validation of the new 'feeding' method for ATRP will allow, in the near future, a significant decrease in the consumption of energy and generation of chemical waste for all companies, which will utilize the ATRP technology for the synthesis of new well-defined and better performing materials.

Endres Machining Innovations

Phase II Award No.: 1026686

Award Amount: $484,965.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Cost- and Energy-Efficient Conversion of Cellulosic Biomass to Bio-Fuel Feedstock of Consistent and Preferred Geometry

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize a new energy efficient long-lifed cutting attachment for chipping cellulosic biomass into bio-fuel feedstock while achieving reduced specific energy, significantly longer knife-change intervals, and controllably-fine chips needed by various bio-fuel applications. The innovation involves an adaptation of advanced metal-cutting technology to replace traditional chipper knives.

The broader impact/commercial potential of the project will derive from creating technology to use inexpensive and readily accessible local feedstock for the production of bio-fuels, reducing the cost of feedstock processing upstream of enzymatic hydrolysis. Energy independence and sustainability along with environmental issues strongly motivate the inclusion of biomass to diversify the national and global energy portfolios. Cellulosic bio-fuels applications are poised to grow, but exhibit technical and economic challenges, one of which relates to the need for finer feedstock particles and the inefficiencies of increased chipping energy and knife wear that come with finer chipping.

Faraday Technology, Inc.

Phase II Award No.: 1058465

Award Amount: $500,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Electroconcentration, Separation, and Rupture of Bioalgae for Fuel Production

This Small Business Innovation Research (SBIR) Phase II project addresses the need for innovative approaches to harvesting oil from bio-algae, specifically to dewater the bio-algae and recycle the processed algae stream for reuse. The subject innovation will facilitate the development of an economical alternative to current technologies, and result in a more favorable application of bio-fuels to the marketplace. Current dewatering technologies (e.g., centrifugation and chemical flocculation) are energy intensive and require chemical additives that can contaminate the oil, resulting in prohibitively high costs to concentrate bio-algae for fuel production. The Phase II program objective is to develop, scale up and integrate the FARADAYIC ElectroConcentration and ElectroFlotation Processes with Harvesting, Dewatering and Drying (HDD) technology being developed by our strategic partner, Algaeventure Systems (AVS), to quickly and efficiently dewater bio-algae.

The broader impacts of this research are in the energy and cost savings that will result from the innovative dewatering process. This technology will enable a cost effective, energy efficient, nearly carbon-neutral source of bio-fuel that does not compete with food crops. Bio-fuel technology is anticipated to have a significant environmental impact by greatly reducing carbon dioxide emissions (e.g. from power plants) by storing the carbon dioxide as lipids. This technology would find applicability in other areas of the algae cultivation industry (bio-plastics, dyes, pharmaceuticals, etc.) and also result in an improved understanding of electric field effects on algae concentration processes. Finally, this project provides opportunities for teachers and undergraduates to gain research experience through the NSF RET/REU programs.

Fleenor Manufacturing Inc.

Phase II Award No.: 0924710

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Anthony Walters

Sector: Chemical Technologies

SBIR Phase II: Reducing Diesel Fuel Consumption in Recovering Woody Biomass

This Small Business Innovation Research (SBIR) Phase II project will build, field test, and prepare for commercialization, a prototype industrial tub grinder with integrated high inertia flywheel technology that will reduce the consumption of diesel fuel in recovering woody biomass. Low-weight, high-inertia flywheel technology can significantly assist the diesel engine duty cycle such that more production can be had with the same amount of diesel fuel consumed. This will in effect lower the cost of grinding woody resources as measured by cost per ton. Each year in the United States alone, an estimated 157 millions of gallons of diesel fuel are consumed in the processing of recovering woody waste streams. The woody waste streams have value in the forms of renewable energy source for electricity co-generation, potential feed stock for cellulose ethanol, engineered wood products such as particle board and press-forms, compost, landscape mulch, and other soil amendments. The USDA estimates that only 5% of the total available woody resources in the United States are currently being utilized. It is expected that recovering woody resources will grow as a source of green, renewable, carbon neutral energy source in the future and hence the need to lower the cost of processing.

The drive to conserve energy and reduce the United States dependence on foreign oil will require a national effort on many different fronts, with each small efficiency gain contributing to that overall goal. The Phase 1 supporting research for this Phase 2 project indicates that a theoretical efficiency gain of 20% is possible with this technology. This Phase 2 project will reduce the diesel fuel consumption and hence total cost of the processing of woody biomass into useful forms. Developing this flywheel technology will make the woody waste stream more viable for energy generation including electricity and cellulose derived ethanol feedstock, reduce the nation's diesel fuel consumption, and it will make the companies involved in grinding woody wastes more profitable and productive. In addition to the impact this technology will have on recovering woody biomass, there are other markets where intermittent diesel engine duty cycles can benefit from developing high inertia flywheel technology. Concrete recycling, rock crushing, automobile shredding, and scrap tire recycling are market examples that can also benefit from adding low-weight, high-inertia flywheel technology to those equipment drive trains. It is expected that the technology developed and commercialized in this project will be applied towards those other markets.

Hans Tech

Phase II Award No.: 1058494

Award Amount: $500,000.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: USV-Grain Refining

This Small Business Innovation Research (SBIR) Phase II project proposes to combine the latest technologies in processing of lightweight materials using ultrasonic vibration(USV), in mold cooling, and in continuous casting, and to develop an enabling USV-GRTM technology for producing metal ingots of ultrafine grains without the use of foreign particles for grain refining. Our Phase I results indicate that the new USV-GRTM technology is feasible in producing metal and alloy products with grain size much smaller than that obtainable using the bst commercial grain refiners. It is expected that the new technology will lead to an increased productivity; reduced defect formation associated with the use of grain refiners containing foreign particles, and improved internal quality of the metal and alloy products.

The broader impacts of this research are in the areas of increasing the use of lightweight metals and alloys for applications i the aerospace, defense, automotive, and metalcasting industries for significant cost savings, energy savings. The implementation of the research results will lead to a breakthrough technology for grain refining of a vast array of metalsand alloys to improve the mechanical and physical properties, particularly ductility and electrical conductivity. The new technology can also impact the efficiency in power transmission since most of the power cables are made of pure aluminm metal that are grain refined using chemical grain refiners. In addition, students involved in the research will have opportunities to interact with industrial partners.

KTM Industries

Phase II Award No.: 1027419

Award Amount: $500,000.00

Start Date: May 1, 2010
End Date: October 31, 2011

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Program Director: Gregory T. Baxter

Sector: Chemical Technologies

STTR Phase II: Designing and Engineering Thermoplastic Starch BioFoam Materials for Protective Packaging Applications

This Small Business Technology Transfer (STTR) Phase II project targets the design and engineering of biodegradable starch biofoam materials for protective cushion packaging and thermal insulation (coolers) market. These new biobased foam materials are expected to displace petro/fossil-based materials used currently in these applications. Previous feasibility demonstration has: (a) established the manufacturability of modified starch biofoams with good moisture resistance, strength, resilience and surface uniformity; and (b) validated the applicability of these biofoam materials in the protective cushion packaging and thermal insulation (coolers) market sectors by major industrial users. The Phase II project will build on these successes and develop robust and cost-effective manufacturing and optimized formulations for broader and greater penetration of the $2.6 billion foam packaging market. The technical advancements implied in this research are expected to significantly accelerate the development of a broader range of bio-plastic products based on bio/renewable feedstocks for successful commercial deployment.

The broader/commercial impact of this project is that it addresses the growing pressures on companies and countries to reduce their carbon footprint, and provide for environmentally responsible and efficacious end-of-life options. The U.S. Government's BioPreferred program identifies biobased, biodegradable foams with minimum 50% biobased content as one of the targeted items for federal procurement. Current foam plastic packaging, based on petro/fossil feedstocks, presents a major disposal problem, as it is lightweight and bulky and so does not lend itself to a viable economic and environmentally responsible recycling operation. It is also not biodegradable, which makes disposal in soil or composting operations untenable. If successful, this project will offer a sustainable, material carbon footprint neutral alternative. The new starch foam products will have the performance of current synthetic plastic foam but can be safely, completely, and efficiently biodegraded in soil or composting operations. These new products will fit both private sector market needs and federal government initiatives.

Metal Oxygen Separation Technologies, Inc.

Phase II Award No.: 1026639

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Low-Cost Low-Impact Magnesium Production by Solid Oxide Membrane Electrolysis

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new method for primary production of magnesium from its oxide ore using Solid Oxide Membrane Electrolysis. Unlike other primary metal processes, this approach emits no direct CO2, has no chlorine, and is fully continuous and automated. Published third party cost modeling has indicated that its costs are lower than all existing and proposed new processes. Building on an earlier feasibility demonstration using experiments and mathematical and cost modeling to show that the approach can produce oxygen as well as magnesium at high current efficiency and at costs close to the published cost model, this Phase II project will develop new anode tubes to further reduce energy costs, and build and test the first self-heating electrolysis cell. If successful, the self-heating cell will not require energy beyond that needed for electrolysis and will be the smallest possible pre-production modular unit capable of producing magnesium.

The broader/commercial impact of this project begins with substantial reduction of the cost and environmental impact of magnesium metal production. Magnesium is the lowest-density engineering metal and third most abundant metal in the earth's crust, and its stiffness-to-weight, castability, and recyclability make it the best material for motor vehicle weight reduction. Automobile makers are seeking to increase the magnesium alloy content of vehicles from 10-15 lbs/vehicle to 350 lbs/vehicle by 2020, replacing 650 lbs/vehicle of steel and aluminum parts. This will increase fleet fuel economy by 1.5-2 miles per gallon, reducing annual petroleum import expenditures by about $20 billion. If successful, this project will address the biggest barrier to widespread magnesium use in vehicles, which is its price stability and availability. This could lead to a new magnesium economy taking full advantage of its light weight and ease of manufacturing in products from cellphones to laptops to trucks. With broader usage, the versatile process resulting from this development project can likely reduce the cost and environmental impact of reducing metal oxides, leading to a new industrial ecology of primary metals production.

MIOX Corporation

Phase II Award No.: 1058239

Award Amount: $491,746.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Investigation of the Use of Chlorine Based Oxidants for Removal of Natural Organic Matter Using Advanced Oxidation Processes

This Small Business Innovation Research (SBIR) Phase II project will build on the successful results obtained during Phase I. Phase I research indicated that aqueous chlorine can be used as an alternative chemical source for Advanced Oxidation Processes (AOPs), and was capable of producing hydroxyl and other highly reactive radicals when illuminated with ultraviolet light. These radicals were harnessed to destroy and mineralize small organic molecules and impact the structure of natural organic matter found in surface water. Phase II research will focus on developing a solid understanding of how aqueous chlorine based AOPs can be integrated into overall water treatment processes, compare the efficacies of aqueous chlorine and hydrogen peroxide based AOPs, and demonstrate that solar ultraviolet light can be used to drive this process.

The broader impacts of this research center around the ability to provide a greener, more efficient AOP which can be used to more economically produce high quality water. Phase II research will deliver an increased understanding of chlorine-based AOP technology, enabling the development of products with enhanced capabilities towards the removal of trace organic contaminants from water. Successful completion of this research will positively impact the quality of both drinking water and packaged beverages. In addition, the research could permanently remove contaminants from the environment through mineralization, preventing unintended release from municipal and industrial wastewater plants. Finally, since this process can be driven using solar energy, the resulting technology will be deployable in rural and developing regions of the world at an affordable cost.

NanOasis Technologies, Inc.

Phase II Award No.: 0956909

Award Amount: $507,530.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Program Director: Ruth M. Shuman

Sector: Chemical Technologies

SBIR Phase II: High Permeability Thin-Film Nanocomposite Membranes for Reverse Osmosis Desalination

This Small Business Innovation Research (SBIR) Phase II project aims to further the development of nanomaterials-based, high permeability, energy-efficient membranes for desalination of water. Membrane-based reverse osmosis (RO) is the dominant desalination technology in many parts of the world, although it provides just a small fraction of potable water demand. This is in large part due to the energy intensiveness of the technology. It is widely acknowledged that improvements in membrane permeability can bring about significant reductions in the energy requirements for seawater RO of between 30-50%. The RO membranes developed under Phase I demonstrated significant improvements in permeability over state-of-the-art membranes, while maintaining a high salt rejection. Phase II aims to scale the process developed in Phase I to produce spiral wound cartridges of an industry standard form factor. The membranes then will be tested to determine their future performance in a large-scale municipal desalination plant.

The broader impact/commercial impact of this project is that the technology is expected to bring RO desalination closer to cost-parity with existing methods of water production. Also, the superior membrane performance achieved in Phase I demonstrates the promise of nanomaterials in RO membrane development. Scaling this process up to the pilot scale will help demonstrate the commercial viability of the technology. In addition, this project is expected to enhance the understanding of the science behind water and ion transport through membranes on the nanometer-scale, an area of current academic interest.

Novarials Corporation

Phase II Award No.: 1026642

Award Amount: $499,995.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Bendable Ceramic Paper Membranes

This Small Business Innovation Research (SBIR) Phase I project will develop bendable Ceramic Paper Membranes for various applications including oil and gas, automotive, food and beverage, biotech, and pharmaceutical. Bendable ceramic paper membranes possess ultrahigh packing density, excellent chemical and thermal stability, high filtration performance and low manufacture cost. Based on the success of the Phase I program, the Phase II project will fully develop and standardize Bendable Ceramic Membrane Technology and set up a foundation necessary for the large scale commercial manufacture of this innovative technology.

Bendable ceramic paper membrane technology will alter the landscape of membrane manufacturing by improving its economics, product performance, and breadth of applications. This will have a sweeping impact on dozens of industries that either currently rely on membrane technology or represent potential new markets for membranes as a result of this breakthrough. These industries include chemicals, gas and oil, automobiles, food, beverage, biotech, and pharmaceutics, and represent a global membrane separation market of potentially $15.1 billion by 2012. Further, given its potential applications in waste treatment, environmental protection, and green energy conversion and storage, this new membrane technology will have additional far-reaching societal benefits.

OnTo Technologies

Phase II Award No.: 0750552
Phase IIB Award No.: 1037924

Award Amount: $1,034,000.00

Start Date: January 1, 2008
End Date: June 30, 2012

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Sector: Chemical Technologies

SBIR Phase II: Recycling Advanced Batteries

The Small Business Innovation Research (SBIR) Phase II project will develop process conditions, recycled materials, and recycling of new battery technologies. Phase I demonstrated that the innovative recycling process can produce materials for new batteries from spent batteries. The Phase II recycling research objectives will (1) Survey advanced battery technologies (2) Improve process efficiency and (3) Recondition used materials. Starting with spent batteries, the project recovers materials, examines utility, and develops methods for recondition based upon physical or chemical limiting issues. The anticipated result of this development is establishment of the most efficient process to recycle high performance battery materials.

The proposed project establishes the most environmentally friendly advanced battery recycling technology as the solution to the next generation's significant environmental challenge. Today's battery recycling options inefficiently bury, burn, or melt spent batteries. This project addresses needs from battery-reliant industries for low-cost recycling with minimal environmental impact; the developed recycling process is the basis for jobs fundamental to the future portable electronics and electrified vehicle markets. The innovation is based upon knowledge from battery life-limiting mechanisms coupled with green-chemical processing techniques. The research actively involves undergraduate researchers at Willamette University in the development and commercialization of energy efficient technologies.

Oxazogen, Inc.

Phase II Award No.: 1026556

Award Amount: $472,135.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Oxidation Resistant Carbon Supports For Fuel Cells

This Small Business Innovation Research (SBIR) Phase II project addresses the need in the marketplace for fuel cells with improved durability. Polymer electrolyte membrane (PEM) fuel cells offer a potential environmentally friendly source of power, but performance improvements are required before costs justify more widespread adoption of this technology. Catalyst deactivation limits the lifetime of commercial PEM fuel cells, as the catalyst support is subject to oxidation and the active metal component, typically containing platinum, sinters during use. This Phase II project addresses both of these problems. Through a combination of new technologies from the ceramics, electronics, and catalyst industries, the feasibility of producing new support materials that are much more resistant to degradation has earlier been demonstrated. Accelerated aging studies have shown dramatic increases in catalyst lifetime, as much as tenfold. Building on these successes, the goals of this Phase II project are development of an optimized process for preparation of this new catalyst system and the production of prototype commercial fuel cell power packs with this new catalyst system. These prototype devices will be tested to demonstrate if the improvements shown in accelerated aging studies translate into longer lifetimes in commercial products.

The broader/commercial impact of this project complements the work reported by others in developing fuel cell catalyst systems with higher activity. Fuel cell systems that combine catalysts with high activity and long lifetime lead to the best overall economics. Fuel cell powered systems also have environmental advantages. The use of fuel cells to generate power leads to a significant reduction in greenhouse gas emissions if they replace systems powered by internal combustion engines. Reductions in emissions as high as 25% have been achieved when fuel cell power supplies replace internal combustion powered systems. The technology to be developed can be used in other applications where attack of a carbon substrate under oxidizing conditions leads to degradation which occurs not only in a variety of catalyst applications but also in electrodes for battery applications.

PolyNew Incorporated

Phase II Award No.: 0822999
Phase IIB Award No.: 1101200

Award Amount: $756,000.00

Start Date: August 1, 2008
End Date: January 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Microwaveable Bioplastic Packaging

This Small Business Innovation Research (SBIR) Phase II research develops innovative nanotechnology to allow the use of bioplastics for food packaging. Polylactic acid (PLA) is an environmentally beneficial bioplastic made from renewable resources; however, the properties of PLA are limited. This makes it unsuited for use in microwaveable food packaging. In Phase I, university expertise resulting from earlier NSF funding was used to formulate a bioplastic with suitable properties, including cost. In Phase II, a viable manufacturing route towards food packing trays will be demonstrated at the pilot plant level working in close collaboration with a large industrial manufacturing partner.

The broader impacts of this Phase II SBIR research will be manifold. The new bioplastics are quantitatively more environmentally benign that petroplastics. Bioplastics are made form renewable resources and therefore simultaneously help decrease dependence on foreign oil while providing environmental benefits. Using a domestic biomass resource provides a competitive advantage against low labor cost manufacturers like China helping to stem job losses in the plastics industries. Presently, polystyrene is largely used for tray applications and foamed with 3-5 weight percent hydrocarbons. PLA can be foamed with carbon dioxide so the new technology has the additional benefit of displacing at least 1 million pounds per year of the pollutant volatile organic carbons (VOCs).

PoroGen LLC

Phase II Award No.: 1048608

Award Amount: $409,578.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Novel Polymeric Membrane for Hydrocarbon Separation

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a novel membrane for a broad spectrum of hydrocarbon separations. The initial focus of the project is the development of a selective membrane for efficient separation of hydrocarbons from methane in natural gas processing and separation of hydrocarbons from hydrogen in refinery applications. The chemically robust polymeric membrane will be of a composite configuration comprised of a hollow fiber porous support with a superimposed several hundred angstroms thick separation layer. The nano-structured morphology of the separation layer will enable selective fractionation of hydrocarbon molecules.

The broader/commercial impact of this project is the reduction of energy consumption currently used in separation and purification of hydrocarbons found in oil and gas. In addition, if successful, petrochemical industries will reduce emissions of green house gases, including methane and carbon dioxide. The membrane will effect molecular level separation of hydrocarbons and will be capable of operation in harsh environments and at high temperatures. The initial market for this technology is the recovery of natural gas and hydrocarbon liquids from the associated natural gas in remote geographic locations (gas generated during oil production) that is currently flared. Development of the proposed technology will enable recovery of the methane and high value hydrocarbons at the well with extensive economic and environmental benefits. The membrane is expected to find further utility in high value gas and liquid separation applications including hydrogen recovery from refinery fuel gas, olefin/paraffin separation, and generic hydrocarbon fractionation.

Proton Energy Systems, Inc.

Phase II Award No.: 1058328

Award Amount: $499,977.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Anthony Walters

Sector: Chemical Technologies

STTR Phase II: Development of High Temperature Membranes for Increased PEM Electrolysis Efficiency

This Small Business Technology Transfer (STTR) Phase II project aims to develop improved membranes for water electrolysis cells, providing a potentially renewable, cost competitive hydrogen source for fueling and backup power applications. Currently, the membrane contributes substantial efficiency losses, and is also one of the highest cost materials in the cell stack. In Phase 1, feasibility of obtaining increased efficiency using new membrane chemistry was demonstrated. In Phase 2, Proton Energy will continue research to understand longer term degradation mechanisms and scale up to a relevant level to prove manufacturability. Proton's academic partner, Penn State, will also build on Phase 1 work, using membrane reinforcement strategies to improve robustness. The proposed membranes represent significantly cheaper and more efficient materials for water electrolysis applications, enabling widespread access to hydrogen for a variety of energy uses.

The broader impacts of this research are new market opportunities in electrolysis and fuel cell applications as well as electro-dialysis and other ion exchange technologies. Creating a new class of mechanically robust proton exchange membranes would be a significant advance in the field and would find immediate commercial interest. The chemistry proposed has the opportunity to decrease the membrane cost by 75%, as well as increasing the efficiency of the cell stack. These combined effects result in substantial potential increases in Proton's existing markets, which are primarily focused on industrial gas and laboratory applications. This project will also enable new applications markets such as vehicle fueling (including fuel cell fork trucks) and telecom backup power.

R&D Green Materials, LLC

Phase II Award No.: 0923863

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Gregory T. Baxter

Sector: Chemical Technologies

SBIR Phase II: Development of Low-Cost, Biodegradable Substitutes for Disposable Plastics

This Small Business Innovation Research (SBIR) Phase II project will use readily available plant protein and innovative, environmentally friendly processes to develop bio-based plastic prototypes such as packaging products. The resulting formulation and production processes for each prototype will meet the needs of large manufacturing companies and consumers who seek biobased and biodegradable products. The prototypes will be designed to meet production requirements, product characteristics and costs that compete with incumbent petroleum-based plastics. Phase II goals are to refine the formulations and processes from Phase I to produce acceptable prototypes for our potential customers, particularly in the packaging industry. The results of a defined formulation and process for each product will enable R&D Green Materials to develop, in Phase III, a scalable pilot process to produce the bio-based products and show that economic implementation can be achieved by our industrial partners.

The project will result in unique processes and technologies to produce biobased, biodegradable plastic products that are functionally equivalent to nonbiodegradable petroleum-based plastics. R&D Green Materials will develop environmentally friendly, cost-effective alternatives to plastic products through technologies that utilize plant-based materials that remain non-toxic from manufacture to disposal. The results will allow industrial partners the freedom to utilize bio-based plastic products without the current problems of high cost and inappropriate characteristics of the process and/or product. As use of the biobased plastics becomes widespread, the general environmental benefits and reduction of plastic pollution is likely to exert a positive effect on human health through reduced exposure to carcinogens and endocrine disruptors. Compared with synthetic polymers, the unique biobased polymers used in the Phase II prototypes can reduce environmental impact, minimize pollution, and conserve resources.

Seldon Technologies, Inc.

Phase II Award No.: 1026891

Award Amount: $490,172.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Functionalized multi-walled carbon nanotubes for making highly efficient water separation membranes for ultralow sulfur diesel fuels

This Small Business Innovation Research (SBIR) Phase I project will develop a water separator media to protect heavy duty engines from the water content in modern ultra low sulfur diesel fuels. The ultra low sulfur diesel fuel typically found in the field has very low interfacial tension allowing water to be present in the form of very fine droplets which pass through conventional water separators and end up in the fuel injection system. This project will quantify and develop a functionalized multiwall carbon nanotube-based water separator to be used with all ultra low sulfur diesel fuels on the market with nearly 100% water removal efficiency. The objective is to enhance the separator performance to cost ratio by working to further increase the separation efficiency and lower the media cost through process scaling and materials development.

The broader impact/commercial potential of the project are focused on benefits related to enhanced ultra low sulfur diesel fuel separation, including more consistent fuel delivery to the engine, longer injector/engine life, better combustion of ultra low sulfur diesel fuel, lower maintenance costs, new jobs enabled by the use of high-sulfur fuel reserves, and more efficient combustion of bio-fuels. Reduced water content in the fuel will help to improve performance of the high pressure fuel injection systems, maintain tolerances of the fuel injection system components, and reduce maintenance costs.

Silatronix, Inc

Phase II Award No.: 0724469
Phase IIB Award No.: 0956436

Award Amount: $1,036,646.00

Start Date: September 15, 2007
End Date: August 31, 2011

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Sector: Chemical Technologies

SBIR Phase II: Integration of Nanostructured Electrodes with Organosilicon Electrolytes for High Energy-Density Supercapacitors

The Small Business Innovation Research (SBIR) Phase II project proposes the development of ultracapacitor devices that combine the use of nanostructured carbon electrodes with organosilicon electrolytes. These innovative ultracapacitor devices are expected to provide higher working voltages than existing devices, yielding significantly increased energy and power density. This Phase II project will use laboratory results to develop prototype devices and address issues associated with scale up and development of procedures for creating prototype devices. These ultracapacitor devices will be characterized for long-term use by evaluating their physical properties and stability.

The size of the ultracapacitor market, already surpassing $200M, continues to grow at a compound annual growth rate of more than 15%. The development of improved ultracapacitor energy storage devices should accelerate this growth by facilitating the commercial development of low-emission vehicles, which should reduce the overall demand for energy. Organosilicon-based electrolytes should improve the overall safety profile of ultracapacitor devices due to their low flammability and low vapor pressures. The improved safety and improved physical characteristics will expand opportunities for the use of ultracapacitors as robust energy storage devices in consumer electronics and industrial applications. This work will also assist in the development of a trained workforce by involving graduate students and postdocs in the research and development effort.

Sioux Manufacturing Corporation

Phase II Award No.: 1058155

Award Amount: $425,627.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Innovative Recycled Microballoon Thermoplastic Sandwich Composites

This Small Business Innovation Research (SBIR) Phase II project will develop the next generation of lightweight materials by utilizing recycled thermoplastic composites to achieve energy efficiency and impact protection for transportation and residential and commercial building applications. Previous work showed that combining fiberglass and thermoplastic face sheets and syntactic foam produced composite panels with greater impact resistance than plywood with aluminum facing. This work will expand the materials and processing envelope to produce a series of composite panels fabricated from recycled glass-reinforced/thermoplastic face sheets and a syntactic foam core consisting of glass or ceramic microspheres and regrind or virgin polymer. The use of hollow microspheres allows the achievement of both low weight and high impact strength while using low-cost extrusion-compression processing techniques. This configuration can be readily tailored to produce panel applications as varied as truck trailer bodies or for protection against flying debris caused by hurricane-force winds.

The broader impacts of this research are the increased use of recycled materials to decrease the weight of commercial transport vehicles, resulting in increased fuel economy and decreased degradation of roadways and bridges. Also, improved systems for impact protection during hurricanes will result in less damage to commercial and residential structures and the loss of fewer lives. The technology of combining hollow ceramic microspheres from the ash of power plants with re-ground polymer waste will produce a material with unique properties that can be applied to a variety of commercial applications.

SustainX, Inc.

Phase II Award No.: 0923633
Phase IIB Award No.: 1045858

Award Amount: $1,013,618.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Anthony Walters

Sector: Chemical Technologies

SBIR Phase II: Pneumatic Energy Storage with Staged Hydraulic Conversion for Low Specific Cost Renewables Support

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop and evaluate a Beta prototype 50 kW 300 kW-hr novel energy storage system. No current energy storage technology can provide low specific cost, high energy density, and long lifetime operation in the mid-capacity range (100kWh - 10 MWh). Particular opportunities exist with renewable energy providers (e.g., wind and solar), commercial & industrial consumers, as well as utilities for services such as capacity firming, consumption smoothing, energy arbitrage, and power regulation. SustainX intends to develop, manufacture and market a disruptive, cost-effective and scalable energy storage device that will serve as an enabling technology for the proliferation of alternative energy generation sources, such as wind and solar power.

Having demonstrated technical feasibility through the Phase I & IB effort, the company's Phase II effort will be dedicated to improving system round-trip efficiency, scaling the technology, and ultimately deploying a Beta system at a customer site. Low cost, long lifetime energy storage has the potential to broadly impact grid stability and reliability, commercial and industrial consumer energy costs, and renewable energy generator value and overall market penetration. As the penetration of wind increases due to renewable portfolio standards, rising fossil fuel costs, public sentiment surrounding climate change and other market pressures, the industry faces a number of challenges. These include, but are not limited to, intermittency of supply, errors in forecasting power production, increased regulation requirements, and transmission congestion. As wind becomes a larger percentage of the energy portfolio, these challenges are compounded. Energy storage has the potential to mitigate these integration issues, thereby allowing wind power to be utilized on a larger scale in a more economically-viable fashion. Specifically, wind generators will be able to use SustainX's energy storage technology to firm capacity, increase peak sales, and enhance ancillary service capabilities. Storage capacity therefore not only represents a significant value to current wind production, but should also be seen as an enabling technology that will allow the world to reach its near- and long-term energy management goals.

Syzygy Memory Plastics

Phase II Award No.: 1026135

Award Amount: $499,994.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Chemical Technologies

SBIR Phase II: Injection-molded Thermoset Shape-memory Polymers with Enhanced Acoustic Properties

This Small Business Innovation Research (SBIR) Phase II project supports the development of a unique manufacturing method to produce novel shape memory polymers in complex shapes. These smart materials can "remember" and reform to a set shape upon an external stimulus. This continuous manufacturing process is vastly more efficient than the current state-of-the-art methods, enabling many low cost applications of shape memory polymers. This project will develop shape memory polymer earplugs that are heat activated by the user's ear and continuously adapt and self-adjust to custom fit any size ear canal. Current material solutions for earplugs suffer from several drawbacks, including an inability to control the force exerted by the earplug upon sensitive inner ear regions that cause pain over time. This effort will address the technical challenges of scaling up the low cost manufacturing process and establish formulations that will enable optimization of its acoustic performance. Human subject testing will be conducted to subjectively validate comfort and objectively validate attenuation with very differently sized ear canals. If successful, this project will yield a device with optimized acoustic properties and comfort ready for first commercial sale.

The broader/commercial impact of this project is the impact of a mass-manufactured shape memory polymer device. Due to their desired properties, shape memory polymers are increasingly used in biomedical applications, but their broader adoption into mass markets has been limited by cost and geometry constraints. If successful, this project will establish a novel manufacturing process that, through modified traditional plastics processing techniques, can mass manufacture a new class of polymers. Thus, the broad impact of this project is twofold: it will establish the first links between sound attenuation and crosslinker density in shape memory polymer earpieces, and it will lay the groundwork for future low cost shape memory devices of complex geometries. Better occlusion and more comfortable earplugs are expected to enable higher usage of protective hearing devices in loud industrial settings. This in turn addresses the growing problem of noise-induced hearing loss in the industrial sector, which according to OSHA, is the number one occupational disease in the US today. In addition, shape memory earplugs may benefit other users including musicians, professional athletes and children with autism. This technology can also be adapted to similar devices including cell phone headsets, Bluetooth audio devices, and hearing aids.

TechDrive, Inc.

Phase II Award No.: 1025712

Award Amount: $481,978.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Low Cost, High Performance Electrolytes for Lithium-ion Batteries

This Small Business Innovation Research (SBIR) Phase II project is poised to introduce superior electrolytes to the lithium-ion batteries by using a new class of low-cost, high-performance lithium salts. Currently, the cost of batteries is impacted not only by the high cost of the lithium salts, but also their relatively lower stability that limits battery lifetime. If successful, these electrolytes, to be developed under this Phase II project, will possess higher ionic conductivity and superior thermal and electrochemical properties that will be very attractive particularly for full size lithium-ion batteries applicable to electric vehicles and hybrid electric vehicles (EV/HEV). Building on the company's earlier success in developing a novel two-step synthetic strategy to prepare these salts which contain two lithium ions versus one in currently used salts, this project will optimize and scale up the synthetic process leading to the production of these salts at much lower cost, while meeting all principal specifications, including high transference number, an attractive property of a battery to function properly at subzero temperatures. This project will also further explore synthetic approaches to deliver even lower cost to capture the small size lithium battery market, where the applications are in computers, cell phones, cameras, and medical devices.

The broader/commercial impact of this project will be in the area of the rechargeable battery industry, especially in the arena of EV/HEV. Cost, performance and battery life are major drivers of this industry. The availability of electrolytes of lower cost, high performance and enhanced stability will contribute to cost reduction needed to make battery driven applications more affordable to users. The successful outcomes of this project are expected to contribute to the US Government's emphasis on renewable energy and particularly, the Department of Energy's roadmap on advanced batteries with more robust and stable chemistries and cost effectiveness.

United Environment & Energy, LLC

Phase II Award No.: 0956737

Award Amount: $413,505.00

Start Date: April 15, 2010
End Date: March 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Continuous Flow Fixed-bed Biodiesel Production from Algae Oil

This Small Business Innovation Research (SBIR) Phase II project proposes to develop, as a pilot, a highly efficient, high throughput, and compact continuous flow structured catalyst fixed-bed reactor unit for cost-effective algae biodiesel production. Successful establishment of the technical feasibility of the integrated fixed-bed technology for algae biodiesel production will be a step forward in addressing the high capital costs, high production costs, and waste stream produced by using a traditional homogeneous alkali-catalyzed biodiesel production process. It will further demonstrate the commercial viability of the technology.

The broader/commercial impact of the proposed project will be economic biodiesel production using algae oil as feedstock, leading to the substitution of petroleum diesel with domestically produced alternative fuel, the reduction of diesel emissions and waste stream generation, the mitigation of global warming, creation of jobs, and the reduction of U.S. dependence on foreign oil imports. Algae biodiesel has the potential to provide a breakthrough solution to both energy security and global warming concerns.

X-Ray Optical Systems, Inc.

Phase II Award No.: 1026559

Award Amount: $499,998.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Quantitative Analysis for Trace Levels of Toxic Elements in Consumer Products Using High Definition X-ray Fluorescence

This Small Business Innovation Research (SBIR) Phase II project will demonstrate rapid, nondestructive, quantitative analysis of trace-level toxic elements in both substrates and coated layers for consumer products in a device fit for purpose on a factory floor. Restrictions such as the Consumer Product Safety Improvement Act of 2008 (CPSIA) are expanding world wide beyond lead to include additional harmful elements at trace levels. The analyzer will provide manufacturers the means to conveniently test their products, raw materials, and components for compliance with the new standards. Currently, there is no practical method to accurately test outside of a lab. The objective is to construct an analyzer for quantifying ten toxic elements at or below regulated levels. The analyzer will use XOS's world-leading x-ray optics to produce multiple monochromatic beams from a single x-ray tube, providing excellent sensitivity, lower limits of detection, and short measurement times for the entire relevant part of the periodic table. It will include advanced software for processing the combined data sets and separating the results for the coatings and substrates. The low-power consumption, reduced maintenance, and compact design are fit for purpose in manufacturing, distribution, or regulatory environments.

The broader impact of this research is the mitigation of inadvertent exposure risk. Toys and other consumer products will be safer as adults and children are protected from toxic elements. American manufacturers, distributors, retailers, and regulators are facing increasing global regulations restricting hazardous substances in manufactured products with associated costs and liability risks. This new testing capability would reduce testing costs by more than 75%, currently more than $1B, compared to existing laboratory-based methods. It would also assist U.S. manufacturers and distributors in cost-effective compliance by testing before the products leave the plant or distribution center, thereby, gaining or preserving their competitive position and avoiding the loss of sales and jobs due to offshore migration of manufacturing. This analyzer will also enable manufactures to safely explore new materials as a substitute for restricted materials. Consumer fears provide U.S. manufacturers an opportunity to increase market share if they can demonstrate safety. Additionally, the societal benefits for consumers are significant. Consumers can be certain the products they buy are safe. The ability to accurately detect toxic elements will help to reduce their proliferation into the marketplace and improve public health. This enables improved quality of life and a reduced health care burden.

ZEOMATRIX, LLC

Phase II Award No.: 0956899

Award Amount: $503,645.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Highly Ordered Membranes for Molecular Separation

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a ceramic nanofiltration membrane with highly uniform pores oriented perpendicularly to the membrane surface using DNA as a template in a silica sol-gel. This membrane will be optimized to perform molecular separation and purification of fuels and chemicals from cellulosic biomass. The research objectives are to create a membrane with the desired pore size and orientation features. A prototype membrane will be produced and tested for its ability to dewater biofuels by pervaporation. It is anticipated that the selective ceramic membrane layer will provide efficient separations and have high temperature and chemical tolerance. The membrane will have applications for a range of industrial markets including wastewater purification and desalination.

The broader impact/commercial potential of this project is the development of an innovative membrane technology that will contribute significant energy savings to the production of alternative fuels from cellulosic biomass. Potential end users will include biorefineries that convert cellulosic biomass to fuels and chemicals. A great advantage of molecular separations by membranes rather than distillation is the 40- 50% savings in energy. If successful, this project would lead to a new class of high-throughput ceramic nanofiltration membranes that will have applications to other industrial sectors, including wastewater purification, natural gas purification, and coal gasification. This project promises to contribute significant energy savings to the production of alternative fuels from renewable resources.

ZUCHEM, INC.

Phase II Award No.: 1026787

Award Amount: $499,996.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Anthony Walters

Sector: Chemical Technologies

SBIR Phase II: Conversion of Biodiesel Glycerol to Xylitol Co-Product

This Small Business Innovation Research (SBIR) Phase II project will develop a method to convert the byproduct glycerol to a value-added co-product, xylitol, thereby helping to reduce the costs associated with biodiesel production. The anticipated result is a scalable process capable of converting crude glycerol to xylitol in a single step bioreactor process and a demonstrated method for recovery of the value-added product.

The broader impact/commercial potential of the project will be to further biodiesel as a replacement for petrochemical diesel. Converting the main by-product of biodiesel production, glycerol, to a value-added product would improve the economics of biodiesel, while removing a waste stream and providing a reduction in price of the co-product. Xylitol itself also has beneficial societal impacts including anti-carcinogenic effects as a safe sweetener for diabetics, and it does not promote new cases of diabetes as some sweeteners are suspected of doing.

BLUEINGREEN

Phase II Award No.: 0750402
Phase IIB Award No.: 1058105

Award Amount: $802,747.00

Start Date: April 1, 2008
End Date: September 30, 2012

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Program Director: Gregory T. Baxter

Sector: Environmental Technologies

SBIR Phase II: A Portable Dissolved Oxygen Delivery System for Rapid Treatment of Organic Spills

This Small Business Innovation Research (SBIR) Phase II project completes the design, construction, and testing of the largest readily portable Supersaturated Dissolved Oxygen (SDOXTM) injection system developed in smaller scale in Phase I. During the first year of the project, the SDOX will be used to study the effect of dissolved oxygen addition on water quality and fish health in the tailrace of a hydroelectric dam. In the second year of this project, the SDOX will be used in the prevention of spills and remediation of waterbodies impacted by organics and phosphorous. The effects of the SDOX on removing DO as the limiting component in aquatic ecosystems will be studied during all four seasons of the year.

The broader impacts of this research are the ability use of a portable SDOX 400 on aquatic ecosystem restoration that has previously been impractical or impossible. This technology benefits an improved environment for aquatic species, minimized environmental impact from hydroelectric dams, and more economic and efficient wastewater treatment. The technology could positively impact drinking water, recreation, irrigation and other aqueous ecological services important to the public and the environment.

Inscent, Inc

Phase II Award No.: 1058580

Award Amount: $494,234.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Anthony Walters

Sector: Environmental Technologies

SBIR Phase II: Rapid Detection of Fecal Contamination in Drinking Water

This Small Business Innovation Research (SBIR) Phase II project concerns a novel, rapid and cost effective detection system for fecal contamination in water supplies. Although existing methods can detect fecal contamination in water samples, improvements are needed in sensitivity, accuracy, and speed. This proposal describes the refinement of a novel sensor utilizing an insect chemosensory protein as the recognition element in a product that detects indole, a characteristic metabolite of coliform bacteria. The biosensor acts with high specificity and sensitivity, allowing the rapid detection of low level E. coli or fecal contamination in water supplies, and encompasses a novel implementation of lateral flow technology that can be used at home or in industry.

The broader impacts of this research are that insect CSP-based biosensors as described constitute a platform technology with direct applications in the detection of environmental, chemical, or biological compounds or contaminants, including the detection of harmful volatile organic compounds (VOCs), quality control of foods and pharmaceuticals, the detection of toxins or stereoisomers generated during chemical or pharmaceutical synthesis, and the detection of volatile compounds present in weapons or explosives. These biosensors can also be used in medical diagnostics as well as numerous other applications where high speed, sensitivity and analyte selectivity are required. The platform technology has immediate application to a variety of important sensor and detector implementations that affect numerous industries, public safety, and public health. The water safety monitor described herein is only one example of the applications possible.

LaunchPoint Technologies, LLC

Phase II Award No.: 1058556

Award Amount: $499,800.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Environmental Technologies

SBIR Phase II: Magnetically Actuated Valve System

This Small Business Innovation Research (SBIR) Phase II project is dedicated to development and testing of Magnetic Valve System (MVS) enabling implementation of electronically controlled variable timing on camless internal combustion engines. MVS is an advanced actuator for intake and exhaust poppet alves utilized in internal combustion engines for control of flows of fresh charge and exhaust gases. LaunchPoint Technologies, Inc. will design and build the MVS actuator and demonstrate its operation on an experimental internal combustion engine. The advantages of MVS technology originate from the nature of the magnetic spring actuator that provides efficient control of the valve position and speed during valve opening and closing events. LaunchPoint's cost-effective and robust technology will enable implementation of highly anticipated electronically controlled variable valve timing on a mass production engine.

The broader impacts of this research are a combination of significant improvements in fuel efficiency, reduction of emissions, and improved power characteristics of conventional spark ignition and compression ignition engines. When a reliable, electronically controlled system is delivered, the economic and social impact of this technology will be broad. The MVS actuator can potentially be used in millions of internal combustion engines employed in automobiles, trucks, bulldozers, and stationary generators. It will enable implementation of emerging advanced combustion technologies such as Homogeneous Charge Compression Ignition and Compressed Air Hybrid. Widespread adoption of MVS actuators would result in substantial decrease of petroleum usage, adverse effects on the environment such as air pollution and greenhouse gas production, and improve energy independence.

Microbial Insights Inc.

Phase II Award No.: 1056963

Award Amount: $499,999.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Environmental Technologies

SBIR Phase II: Microbial Source Tracking Using Mitochondrial DNA for Identification of Contaminant Sources

This Small Business Innovation Research (SBIR) Phase II project will result in field validated microbial source tracking (MST) assays that provide cost-effective identification of sources of fecal pollution. Despite efforts mandated under the BEACH and Clean Water Acts, beach closures have exceeded 20,000 days in each of the last four years primarily due to fecal pollution. The problem continues because traditional methods cannot identify the sources of fecal contamination (sewage, livestock, domestic animals, wildlife). MST assays employing quantitative polymerase chain reaction (qPCR) were developed to quantify source-specific genetic markers encoded on the mitochondrial DNA (mtDNA) of the source animal (human, cattle, dog, etc.). The Phase I results demonstrated that mtDNA-based assays combined with bacterial source tracking methods will provide conclusive identification of fecal contamination sources allowing implementation of corrective measures to improve water quality and protect human health. Phase II studies will include a modification of the DNA extraction procedure to permit quantification of live fecal bacteria to aid in risk assessment and extended field validation studies at two beaches and two coastal watersheds impaired by unknown sources of fecal pollution.

The broader impacts of this research are that the MST assays developed and validated during the Phase II project will empower stakeholders with the type of actionable data required to identify fecal contamination sources, implement appropriate corrective actions, and safeguard the nation's waters. Fecal contamination of water resources currently exacts a severe toll in terms of increased risks to human health and impacts on coastal economies.

OndaVia, Inc.

Phase II Award No.: 1058590

Award Amount: $461,020.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Anthony Walters

Sector: Environmental Technologies

SBIR Phase II: Hand-Held Device for PPB-level Water Analysis

This Small Business Innovation Research (SBIR) Phase II project will move OndaVia's water contaminant detection technology from proof-of-concept to commercial prototype. As experts in microfluidic design, OndaVia uses its innovations to manufacture devices that provide near real-time, precise water analysis in the field. Our Phase I SBIR project goal was to prove the feasibility of detecting 100 part-per-billion-level water contamination using an embedded surface-enhanced Raman spectroscopy (SERS) region within a microfluidic channel's goal achieved with excellent results. The objective of this Phase II effort is to build a prototype water analysis system, the anticipated results of which will set the stage for rapid incorporation of this proprietary detection technology into OndaVia's line of analytical instruments.

The broader impacts of this research are emphasized by the belief that the world is running out of "quality" water. Reservoirs are depleting, ground water is frequently contaminated through petroleum extraction, and new industrial contaminants are found in lakes and rivers every day. Typical analysis requires collecting a sample in the field and shipping the sample to a test laboratory; water monitoring agencies depend upon these outsourced laboratories where transport and processing time can take days to produce results, wasting precious time when the health of a community is at stake. Field-ready, real-time measurement tools that detect a wide array of compounds at a parts-per-billion or better level would be a powerful, valuable, and necessary addition to the water testing toolbox.

Reactive Innovations, LLC

Phase II Award No.: 0956791

Award Amount: $411,588.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Program Director: Anthony Walters

Sector: Environmental Technologies

SBIR Phase II: Electrochemical Ozone Generator

This Small Business Innovation Research (SBIR) Phase II project will develop a water disinfection system based on an electrochemical generator that produces ozone directly into process water. Because of its excellent disinfection and oxidation qualities, ozone is widely used for drinking water and process water purification treatment. Ozone has been proven to deactivate resistant microorganisms such as Cryptosporidium Parvam and Giardia Lambia that have caused a large number of epidemics in the United States through drinking and process water. To enable wider adoption of ozone as an disinfectant, improvements in ozone generators are needed that are safer to operate than the corona arc discharge systems and that are more cost effective to install and operate. Building on demonstration of technical and economic feasibility during Phase I, this Phase II project will develop an electrochemistry based water disinfection system for commercial deployment. The Phase II program will focus on finalizing the electrocatalyst formulation, optimizing the module design for performance and cost, incorporating the reactor module into a packaged end-use product, and evaluating the process for disinfecting water in field applications using strategic partners.

The broader/commercial impact of this project is an improved and lower cost disinfection system that will prevent the vast outbreaks of contaminated water that harm the general public. These occurrences push the utmost urgency for advanced quality control methods, especially in food manufacturing. With the wider adoption of ozone generation systems, both water and food-borne diseases would diminish due to its effectiveness as a disinfectant against Lysteria, Salmonella, E. coli, and any other pathogens found in fruits, vegetables, meats, and seafood. Contributions to the scientific and technological field will be realized by the improved electrochemical reactor design and catalyst development that enables an ozone disinfection system that is low in cost and energy efficient.

Rheonix, Inc

Phase II Award No.: 1057685

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Anthony Walters

Sector: Environmental Technologies

SBIR Phase II: A Fully Integrated Molecular Biosensor for Rapid Monitoring of Recreational Water

This Small Business Innovative Research (SBIR) Phase II project will complete the development of a rapid biosensor for the detection of fecal contamination in recreational water (both fresh and marine). Under current EPA guidelines, marine water should be tested for the presence of enterococci while fresh water can be tested for either enterococci or E. coli, but all testing is hampered by a 1-2 day delay before results are available. The current project will permit this testing to be completed in approximately 3 hours, thereby dramatically improving the safety of U.S. recreational waters. It will also provide the US EPA with a means to satisfy a court-ordered requirement to reduce the time of current recreational water testing to "same day" results.

The broader impacts of this research are that the CARD? technology can also be used to test water parks and swimming pools for other pathogenic microorganisms. Moreover, the CARD? technology can be used in other markets such as drinking water safety, food/beverage testing, therapeutics manufacturing, personal care product testing, and human/veterinary diagnostics. In addition, since the fully automated, portable system does not require operator input, individuals of varying skill levels will be able to easily perform sophisticated molecular assays that would otherwise have required extensive training and equipment. Therefore, in applications that require rapid turnaround of results, such as production floor analysis of in-process or finished products requiring bio-burden analysis, the CARD technology will provide an economical and easy solution to improving manufacturing efficiencies.

Sensor Electronic Technology, Inc.

Phase II Award No.: 1026217

Award Amount: $475,227.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Anthony Walters

Sector: Environmental Technologies

SBIR Phase II: UV LED Lamp Based Water Disinfection for POU Compact Purification Systems

This Small Business Innovation Research (SBIR) Phase I project will establish a commercial water disinfection system based on the use of light emitting diodes that would be appropriate for use in residential settings. The Phase II effort will redesign the system so that the removal efficiency may be enhanced and the packaging of the system will be more versatile. An enhancement of the efficiency would be accomplished by minimizing the optical loss. The repackaging would be accomplished by changing the external casing for the device from stainless steel to plastic material and also encapsulating the light emitting diodes.

The broader impact/commercial potential of the project is the development of commercially viable and environmentally safe technology for UV water disinfection. The primary market segment addressed through the work that will be performed under this Phase II effort is the microbial disinfection of water for point-of-use and point-of-entry applications in household systems, appliances, and remote and rural areas. Incorporation of innovative UV light emitting diode (LED) lamps in water purification modules will enable cost effective and environmentally friendly technology for water purification designed for a variety of water supplies including residential, remote, and emergency relief.

Structured Materials Industries, Inc.

Phase II Award No.: 1058439

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Anthony Walters

Sector: Environmental Technologies

STTR Phase II: Graphene Based NOx Detector

This Small Business Technology Transfer (STTR) Phase II project will develop a low-cost, high sensitivity detector for nitrogen oxides (NOx). The detector will be based on the recently discovered material - graphene. In its most elemental form, graphene consists of a single layer of carbon atoms arranged in a hexagonal array. Since first isolated in 2004, scientists have been rapidly documenting the unusual physical and electrical properties of graphene, and the many potential commercial applications of this unique and multifunctional material. Gas detectors, such as the presently proposed NOx sensor, will be the first commercial application for graphene based devices. Graphene films can potentially detect down to a single molecule of an adsorbed gas.

The broader impacts of this research are that the availability of an effective, inexpensive NOx sensor will enable closed-loop control of engine conditions in auto and truck applications, allowing manufacturers to simultaneously optimize vehicle performance and fuel economy, while maintaining NOx emissions within standards. A portable version of the inexpensive NOx sensor will also enable emissions monitoring for a wide range of other industrial and regulatory applications. In addition, the technology developed will extend the knowledge base for graphene material processing and device applications. Many more applications for graphene are possible, ranging from high speed transistors to spintronic devices to radiation detectors (THz through infrared to optical) to NEMS devices. Graphene also offers the potential to combine these functions into a single device.

United Science LLC

Phase II Award No.: 1058472

Award Amount: $500,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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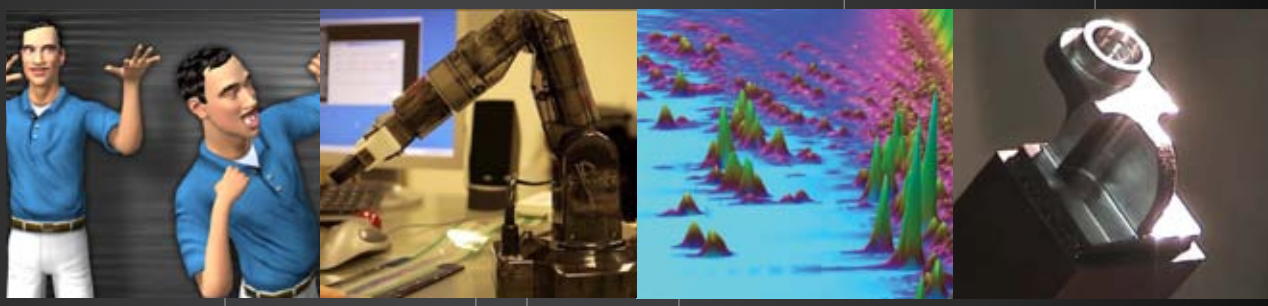
Sector: Environmental Technologies

STTR Phase II: Chemical Sensors for In Situ Monitoring of Collector Chemicals in Complex Copper Mine Effluents

This Small Business Technology Transfer (STTR) Phase II project addresses unmet analysis needs of froth flotation, a separations process widely used in the mining industry to separate worthless gangue from desired mineral particles. Phase I work has demonstrated the preparation of sensor membranes that permit the measurement of collector chemicals used in flotation suspensions. These sensors have been shown to be ideally suited for these measurements since they are not affected by turbidity, have high selectivity for collectors, and require no off-stream sample handling. The project will take advantage of the highly selective and fouling-resistant fluorous perfluoropolymer membranes introduced by the academic partner Phil Buhlmann. The Phase II project will optimize the sensing membrane characteristics to improve ion conduction and robustness. It will also assess the factors that affect sensor lifetime and engineer several prototypes to test at mining operations.

The broader impacts of this research are significant as it will enable the mining industry to be more sustainable in its approach to mineral recovery. Specifically, the research aims to significantly reduce the amount of toxic chemical waste associated with froth flotation and its inevitable environmental impact. The method has the potential of making the U.S. copper industry more competitive by reducing wasted collector while simultaneously improving mining sustainability by eliminating an estimated 24 tons of unnecessary chemical discharges. In addition to these benefits, the multidisciplinary aspects of this project will train students in synthetic and analytical techniques, involving concepts from chemistry, materials science, and engineering.

EDUCATION APPLICATIONS



Advanced Science and Automation Corp.

Phase II Award No.: 0848966

Award Amount: $636,000.00

Start Date: March 1, 2009
End Date: February 29, 2012

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Sector: Education Applications

SBIR Phase II: Virtual Learning Environment for University Physics

This Small Business Innovation Research (SBIR) Phase II project proposes the development of a web-based collaborative Virtual Learning Environment for teaching freshman university physics, called the Virtual Physics Lab (VPL). The VPL will deliver an individualized self-paced learning experience using high-end multimedia lectures, and interactive virtual-reality simulations. The multimedia lectures are delivered using a synchronized multimodal combination of both highlighted text and speech that is delivered by near-photorealistic intelligent animated virtual instructors. The multimedia lectures include interactive Flash animations, movies, and 2D/3D animated illustrations. The VPL's interactive simulations are delivered in a video-game-like 3D virtual environment using physics-based models to simulate physics concepts such as pendulums, impact, buoyancy, magnetism etc. The VPL is highly interactive and uses pre-topic, in-topic, and post-topic questions to keep students engaged and to assess whether or not students need further training in any given subject. The VPL also includes collaborative/competitive mini 3D computer games that use relevant physics principles to increase the students' interest about the material being taught, and to add entertainment and competitive dimensions to the learning experience. The VPL's interactivity and the visually stimulating instruction will result in faster assimilation, deeper understanding, and higher memory retention by the students than traditional text-book/classroom learning.

The VPL has the potential to radically change the way physics is taught. Due to the current exponential rate of increase in human scientific and technical knowledge, there is a need for students to assimilate more knowledge at a faster rate. Current classroom and text-book instruction delivery methods cannot satisfy this need due to a variety of reasons, including, delivery of the lecture in non-engaging and minimally interactive way, use of antiquated static graphical illustrations, variability of teacher skill, lack of one-on-one teacher attention, and variability of student learning styles and speeds. The VPL will help overcome those limitations. Particularly, it will enhance the quality, accessibility, and speed of learning. It will enhance the student experimentation, creativity and problem-solving capability. Freshman university physics was chosen because it is one of the essential foundations for training high-caliber engineers and scientists who will ensure the continued leadership of the US in developing new technologies and in conducting cutting-edge scientific research. The US market for the proposed learning tool is estimated at 500,000 licenses per year. A larger market exists worldwide in English language speaking countries, and for future versions of the VPL that will be translated into other languages.

Animated Speech Corporation

Phase II Award No.: 0956881

Award Amount: $561,843.00

Start Date: February 1, 2010
End Date: January 31, 2012

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Program Director: Glenn H. Larsen

Sector: Education Applications

SBIR Phase II: iGlasses: An Appliance for Improving Speech Understanding in Face-to-Face Communication and Classroom Situations

This Small Business Innovation Research (SBIR) Phase II project will complete the development of technology to supplement ordinary face-to-face language interaction for the millions of individuals who are deaf or hard of hearing or face other speech/language challenges. The goal of the project is to enable such individuals to fully participate in the spoken language community. The need for language and speech intelligibility aids is pervasive in today's world. Millions of individuals live with language and speech challenges (such as 36 million Americans with hearing deficits), and these individuals require additional support for communication and language learning. The Phase I research developed and tested the behavioral science and technology for iGlasses. Building on this research, the proposed research is to complete and bring to market an innovative intervention that can bring spoken language and culture into the lives of individuals who are currently marginalized because of hearing loss or other speech/language challenges. The proposed research will advance the state of the art in human machine interaction, speech, machine learning, and assistive technologies.

The broader/commercial impact of this project will benefit the deaf and hard-of-hearing populations as well as the scientific community by providing a research and theoretical foundation for a speech aid that would be naturally available to almost all individuals at a very low cost. It does not require literate users because no written information is presented as would be the case in a captioning system; it is age-independent in that it might be used by toddlers, adolescents, and throughout the lifespan; it is functional for all languages because it is language independent given that all languages share the same phonetic features with highly similar corresponding acoustic characteristics; it would provide significant help for people with hearing aids and cochlear implants; and it would be beneficial for many individuals with language challenges and even for children learning to read. Finally, regardless of the advances or lack of advances in speech recognition technology, it will always be more accurate and effective to pick off the fundamental acoustic features of speech than it is to recognize entire phonemes which are more complex combinations of these basic properties.

Berkeley Exotech, Inc.

Phase II Award No.: 1026872

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Education Applications

STTR Phase II: Integrated Powered Knee-Ankle Prosthetic System

This Small Business Technology Transfer (STTR) Phase II project proposes the development of an integrated powered knee-ankle prosthesis. The objective of this proposal is to investigate the use of integrated powered knee and ankle joints in trans-femoral prostheses that use sensory information from the ground and the wearer. The hypothesis is that a prosthesis with actively powered knee and ankle joints will significantly enhance the mobility of trans-femoral amputees while walking on level grounds, as well as stairs and slopes. The inability to deliver power to prosthetic systems has significantly impaired their ability to restore many locomotive functions. This proposal will derive a set of guidelines on design and control of an integrated powered knee and ankle prosthetic system which will improve locomotion function such as walking up stairs, walking up slopes, running, jumping, and as hypothesized in this proposal, even level walking. The proposed work will result in new theoretical frameworks for control and sensory systems, and the design of such systems. Major intellectual contributions will include the design of power systems; development of the sensory system to obtain information from the ground and from the user; the development of a control framework for the interactive control of prostheses; and the development of adaptive and robust controllers for impedance modulation during locomotion.

This project intends to create principles that provide significantly greater functional capabilities for above-knee amputees. Specifically, our work will enable more natural, stable, and adaptable prostheses. These research elements in this proposal will also form a foundation for powered orthotic systems. Additional significant benefits of this work include fostering a broader awareness and increased sensitivity of young engineers and educational institutions to disability issues. Limb loss is also afflicting a growing number of military personnel serving in recent conflicts, as well as a far larger number of veterans from previous wars. The recent Middle East conflicts have resulted in a number of young amputees, many of whom still shoulder the responsibility of raising families and anticipate a working life ahead of them. The integrated knee-ankle prosthetic proposed here will have a direct impact on the mobility of the trans-femoral amputees and their quality of life, and most likely alleviate the long-term consequences related to musculoskeletal health.

CVISION Technologies, Inc.

Phase II Award No.: 0924549

Award Amount: $621,960.00

Start Date: September 1, 2009
End Date: February 29, 2012

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Sector: Education Applications

SBIR Phase II: Real-time, Accurate OCR from Documents using Intra- and Inter-Frame Machine Learning

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project involves development of real-time algorithms for Optical Character Recognition (OCR) from documents. This real-time recognition (RT/OCR) system, to be fully developed under this SBIR award, performs recognition an order of magnitude faster than current commercial systems and will allow for real-time recognition that can be embedded on a system device and done at the time of capture. The RT/OCR system will also have no loss in recognition accuracy, and will, in fact, be more accurate for complex documents that include color, graphics, and multiple fonts.

This technology, when successfully commercialized within Phase II of the SBIR award, could be deployed on every corporate MFP and digital copier device, converting corporate paper to searchable, electronic files and bringing us one step closer to the paperless office. The technology we intend to use in developing this real-time OCR recognition system is based on methods using Intra- and Inter-Frame Machine Learning. The algorithms to be developed are not, in any way, language specific and can run on virtually any platform (e.g. server or handheld device). The basic technology is completely different from the recognition kernels of current commercial OCR recognition systems. This project is focused on developing revolutionary technology that will take OCR technology to a new level. This technology is designed to bridge the gap between paper and digital media, a much needed engine for Bill Payment Machine (BMP), document capture and document processing industry. The capture industry will grow to $2.42 billion in 2010, a CAGR of 16.4%. Real-time OCR for automated and semi-automated field coding addresses the needs of an industry that uses $14.5 billion/year of manual labor just in the US. RT/OCR will be part of a solution that addresses manual paper-based indexing for complex documents, potentially saving the industry and the government billions of dollars every year. This recognition technology, after being successfully developed and commercialized within the context of the Phase II research and development, can be generalized and extended to handle real-time video recognition, with application to autonomous vehicle navigation, aids for the visually impaired, and robotic factory automation.

GOKNOW, INC

Phase II Award No.: 1058251

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Education Applications

SBIR Phase II: Understanding Science Processes Through Modeling and Animation: Efficiently Producing Low-Cost Software Tools for K-12

This Small Business Innovation Research (SBIR) Phase II project seeks to address a need in science education that is non-linearly becoming a serious problem. In general, educational technology has had a weak track record for positively impacting student understanding in the area of science. Research clearly suggests that students' use of science simulation programs does have a positive impact on their achievement and understanding. There is a dearth of such software, and the simulations that are available are heavyweight- typically computationally, financially, curricularly, and cognitively demanding. The GoKnow AniModeler Software Factory seeks to demonstrate how to build a software factory that can deliver 36, lightweight science simulations for $1 per student per year! During our Phase I SBIR effort, the company will develop the object-oriented architecture underlying the AniModeler simulation engine. Their challenge in Phase II is to build a factory system that exploits that architecture such that the creation of a simulation program ' an AniModeler ' is done by a science educator without any programmer assistance and it outputs, automatically with versions for 5 operating systems. Supporting consumer functionality such as, mobile and lightweight applications are the future of software development.

The broader impact/commercial potential of this project addresses the full range of stakeholders: (1) In contrast to activities such as filling out worksheets, in using GoKnow's AniModelers in collaboration with their peers, students will see science as a social activity, sparked by a desire to understand how and why- not as a boring, solitary activity. Students will see science as a fun activity- successfully understanding how and why something works is a good, fun feeling. (2) Teachers will see that lightweight, easy-to-learn-to-use, narrowly focused apps - just like the apps on their smartphones - are much easier to integrate into their existing curriculum when compared with typical educational software that is expensive and so profusely functional that it takes excessive class time to learn. (3) Educators will see that educational software doesn't necessarily need to cost an arm and a leg, and that Open Source is not the only alternative. (4) Science publishers will see educational software as positively contributing to the value of their print offerings - especially when they make money from the software. (5) And, last but surely not least, AniModelers can demonstrate to software developers that educational software can be a lucrative business!

Inquus Corporation

Phase II Award No.: 0923847
Phase IIB Award No.: 1038589

Award Amount: $724,215.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Glenn H. Larsen

Sector: Education Applications

SBIR Phase II: Social Marketplace for E-learning

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to create the first on-line social studying platform that allows students to connect, share and learn together. The application is focused on high school and college students. The proposed platform, called OpenStudy, combines both theory and practice in a seamless user-friendly environment that empowers the individual user to learn, create and share their knowledge. OpenStudy will make education accessible, by connecting students of varying levels of expertise, age, location, and social graph; and fun, by providing a social learning experience with peer-to-peer sharing and validation.

In the face of globalization and Thomas Friedman's 'flat earth' economy, competing through education is a fundamental need whose importance is being recognized at a national level. Students and educators alike recognize the need for innovative technologies in addressing this problem. Yet according to leading market analysts, the e-learning supply chain is rooted in old business practices and unable to meet the needs of the new buyers. 'The State of Our Nation's Youth' survey reports that high school students feel the pressure to compete with better grades. Despite the rapid adoption of learning management systems by institutions and of social networks by individual students, there is no systematic solution to this problem nor an application in the education field. Significant technical and business innovation is required to introduce a solution to this problem. The OpenStudy platform seeks to accomplish this change by creating a peer-to-peer learning community to provide a social learning experience for its members. Leveraging the wisdom of a community, OpenStudy will enable students, faculty and alumni to engage in a national conversation focused on learning.

LectureTools Inc.

Phase II Award No.: 1058560

Award Amount: $445,701.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Program Director: Glenn H. Larsen

Sector: Education Applications

SBIR Phase II: LECTURETOOLS - An Integrated Textbook/ Learning Management System

This Small Business Innovation Research (SBIR) Phase II project aims to commercialize Lecturetools, an in-class integrated learning environment, to improve the quality of large, gateway higher education courses. Faced with the emerging online distance learning initiatives, traditional face-to-face oriented institutions are challenged to respond with innovative teaching approaches that validate their long established face-to-face teaching model. Many studies have shown poor student engagement and retention rates in traditional large-scale collegiate classrooms. At the same time, the model of using expensive, printed course textbooks is under great pressure - simply providing monolithic textbooks, printed or electronically, is not sufficient for successful student engagement or learning. An NSF panel considered the state of the college textbook and summarized that: The textbook of the future will be the organizing hub of an integrated learning environment where the student experience is key. The combination of advancements in web-based technology and the proliferation of laptops among students offer an opportunity to address both of these issues. LectureTools Inc. proposes to deliver an integrated learning environment that joins textbook materials with student response and inquiry, lecture delivery and student note-taking functionality.

The broader impact/commercial potential of this project results from the integration of multiple in-class learning tools strategically aimed at improving the educational opportunities in large gateway courses. These courses, with hundreds of students, too often offer few opportunities for active, engaging learning. Clicker companies offer multiple-choice student response systems, but few other question types, no direct access to textbook content and little, if any, functionality for student questioning or note taking. Course management systems (e.g. Blackboard, Moodle, Sakai) have been successful in organizing course assignments, grading and resource sharing that happen outside the classroom, but have not penetrated the in-class experience where LectureTools is uniquely targeted toward improving student engagement and learning. Publishing companies offer online access to textbooks, but not integrated with in-class activities. With the student response market projected to be $290M and the overall textbook market projected to be $6B by 2014, LectureTools is well positioned to capture a sizable proportion of these markets. The University of Michigan serves as a testbed and is offering a LectureTools to all courses starting in the fall, 2010. Contracts are already in place with major textbook publishers to supply the initial textbook content.

Modular Robotics LLC

Phase II Award No.: 0956809

Award Amount: $502,906.00

Start Date: April 15, 2010
End Date: March 31, 2012

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Sector: Education Applications

SBIR Phase II: Learning About Complexity through Programming Modular Robots

This Small Business Innovation Research (SBIR) Phase II project investigates end-user programming for ensembles of robots. The project focuses on the development of an accessible end-user programming environment so that middle and high school students can create their own custom ensembles or blocks of robots and observe how the blocks' behavior affect an entire robot. Building powerful and correct intuitions about the behavior of complex systems is important for scientists and engineers, but with today's technologies it is difficult for children to acquire and integrate these ideas into their mindset. Through exploratory play with the proposed robotics construction kit, which embodies a distributed processing scheme for embedded microprocessors, children can build and observe complex systems acting in the real world. Although end-user programming environments exist for software systems, and even for a few robotics toys, no competing approach to end user programming tackles distributed processing for modular robotics. The project aims to build three experimental systems: a text-based environment, a visual programming language, and a 'cellular automata' interface. Testing with local middle school students will determine the benefits and drawbacks of each approach.

The broader/commercial objective of the project is to give children a vehicle to explore how complex global behaviors emerge from local effects. Designing and building complex systems exposes children to a variety of science, technology, engineering and mathematics (STEM) concepts. The programmed kit, without the end-user programming component proposed here, already introduces these important concepts. The addition of an intuitive, low-threshold, high-ceiling approach to reprogramming individual modules will add extensibility to this already powerful model of complexity. A commercial version of kit will be released in three phases: to science centers and children's museums initially, to a core community of technically savvy enthusiasts, and finally to the public through retail channels. Several science centers have expressed serious and persistent interest in acquiring initial versions of the kits and incorporating them into robotics education programs and exhibits. In addition to the project's primary objective, the design and testing of end-user programming for distributed embedded computing can inform other applications of this technology in the rapidly growing area of modular robotics.

New Renaissance Institute

Phase II Award No.: 0923986

Award Amount: $618,000.00

Start Date: September 15, 2009
End Date: February 29, 2012

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Sector: Education Applications

SBIR Phase II: A Novel, High-Dimensional Touchpad

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project addresses an opportunity to build on the recent enthusiastic market acceptance in touch interfaces with a new exciting feature-enhanced technology. The patented high-dimensional touchpad (HDTP) employs a tactile matrix sensors to capture nuances of finger contact that current touch interfaces cannot detect. Machine vision techniques are used to extract control information from measured tactile contact and direct it to control a system or device. The HDTP has all capabilities of available touch interfaces with far more continuously-variable parameters from a single finger and numerous new features. The SBIR Phase II project objectives are: 1) create a working HDTP prototype from the test system of SBIR Phase I; 2) characterize suitability of available tactile matrix sensors for commercial HDTP products; 3) develop expanded repertoire of touch interactions combining existing techniques with others unique to the HDTP; and 4) conduct human studies comparing the HDTP with other touch interfaces. Expected outcomes of this Phase II project are: a working prototype providing eight or more useful continuously-variable parameters (four or more in a small area); identification of best suited sensors; an expanded range of touch interaction techniques; human study results showing HDTP capabilities surpasses those of other touch interfaces.

The past eighteen months have seen the emergence of a new generation of touch interfaces that exploit multi-touch and gesture interactions to create user interfaces substantially more usable than other user interfaces. With the success of the iPhone, advanced touch interfaces are now appearing in a variety of products ranging from laptop and multi-user table-top computers to PDAs to competing smartphones to digital cameras. The heightened interest in touch interfaces and their increasing prevalence make finding ways to improve them especially important. Considerable effort is now being devoted to developing advanced touch interfaces. The proposed project will advance that research. As a high-dimensional touch interface operated in an intuitive way with a wide range of powerful new capabilities, a large number of possible applications, and well-suited for use in handheld devices, the HDTP has the potential to be very widely adopted. Because of the size and number of potential markets for the HDTP, even a modest market share in some of them could result in substantial profits. Further, the HDTP's sensitivity and adaptability makes it well-suited for use as an assistive device for the disabled, thus promoting the goal of universal access.

Product Innovation and Engineering, L.L.C.

Phase II Award No.: 0822739

Award Amount: $734,000.00

Start Date: August 15, 2008
End Date: July 31, 2012

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Sector: Education Applications

STTR Phase II: A Multi-Axis Planning System (MAPS) for Direct Fabrication Processes

This Small Business Technology Transfer (STTR) Phase II research project focuses on the development of an innovative Multi-Axis Planning System (MAPS), for layered manufacturing processes. By enabling current direct metal deposition systems to fully control and utilize multi-axis capability to make complex parts, MAPS will enable fully-automated process planning for multi-axis layered manufacturing processes to directly control metal deposition machines used in automated fabrication. The building of complicated shapes without support structures is a major challenge for current direct metal deposition processes. This proposed Phase II research will continue to research and develop the 'centroidal axis' algorithm in multi-axis slicing, with an emphasis on completeness and robustness for complicated shapes such as geometry with multiple loops and internal structures. This algorithm will allow manufacturing systems to handle parts with multiple loop features. Additional features to be developed under this Phase II project include a deposition visibility map for efficient computation on the collision-free slicing/deposition sequence in a multi-axis scenario, and a '3-D layer' toolpath generation which will provide an alternative turning algorithm for the deposition process.

The proposed project will impact the manufacturing industry by incorporating fully-automated multi-axis control capability into the rapid manufacturing industry to produce fully functional metal parts with complicated shapes. This capability will lead to dramatic reductions in lead time and manufacturing costs for high-value, low-volume components with high performance material. Assuming the outcomes are successful, the project will several segments such as aerospace, military, motor sports, automotive, industrial machinery, medicine, dentistry, and consumer products.

Syandus, Inc.

Phase II Award No.: 1058156

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Education Applications

SBIR Phase II: An Immersive 3D Simulator to Experientially Learn Immunobiology as a Networked System

This Small Business Innovation Research (SBIR) Phase II project will build on previous work to produce a transformative learning resource: a first-of-its-kind simulator that applies an innovative approach and advanced 3D interactive technology to learning the complex interrelationships in immunology. The company has used simulation-based learning technology platform to convey disease state concepts and clinical best practices to physicians for large pharmaceutical companies. This project extends this technology and approach to the study of immunology in higher education. Like many areas of science, immunobiology involves complex systems. The company is using an engineering paradigm to create a model immune system that is compartmentalized into elements that interact, forming a responsive whole. When this system is brought to life through interactivity and 3D visuals, students will experience how the immune system functions instead of reading about it. The company will work with educators and immunologists to build this simulator to fill recognized gaps in understanding this science. This Phase II project will result in a commercial version of the Immunobiology Simulator that will be marketed to colleges, universities, and medical schools with strategic science publishing partners.

The broader/commercial impact of this project will be the potential to create an Immunobiology Simulator that facilitates the comprehensive understanding of the immune system through direct experience of the interactions between its essential parts. This systems approach is a forward-thinking one that when combined with technology creates a new way to experience and learn immunology. Understanding the immune system is critical for advancing the battle against infectious diseases, autoimmune diseases, cancer, asthma, and many other disorders. Immunology is an essential component in sustaining our nations competitiveness in the life sciences. It is a growing element of biology, bioengineering, nursing, and medical school curricula, with 29 schools already offering a dedicated immunology major. The Immunobiology Simulator will be accessible over the Internet, providing broad distribution. With content oversight by accomplished immunologists and educators, it can also be a trusted remote resource to students at institutions that do not retain faculty members with this expertise. The firms systems approach can also be applied to virtually any complex scientific topic using the same Syandus platform and expertise, allowing them to expand the business and impact other areas in life science education

Tertl Studos LLC

Phase II Award No.: 0924706

Award Amount: $536,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Education Applications

SBIR Phase II: Algebra Immersion Robotics

This Small Business Innovative Research (SBIR) Phase II project uses an iterative design research method to investigate the technical and curricular innovations need to maximize the algebra learning value of educational robotics. The research objectives of this project address: 1) software tools to make core algebra concepts accessible and useful in a robotics context; 2) activity design; 3) curricular architecture; and 4) evaluation, including summative evaluation of learning outcomes.

If successful, this SBIR Phase II project will lead to products enabling over a million young people to gain confidence and conceptual grounding in algebra. The project will help to break down the artificial and detrimental wall between school mathematics and the tools and concepts that underlie the information economy. Finally, this research will demonstrate advances in the structure of learning environments, showing how rigorous learning can be more portable, more individualized, and more interwoven with creativity and play. "This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)."

The Learning Chameleon, Inc.

Phase II Award No.: 0822020
Phase IIB Award No.: 1060745

Award Amount: $664,136.00

Start Date: November 15, 2008
End Date: October 31, 2011

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Sector: Education Applications

SBIR Phase II: A Value-based Approach for Quantifying Problem Solving Strategies

This Small Business Innovation Research (SBIR) Phase II research project will investigate methodologies required to scale and disseminate an online performance-based assessment system for quantifying the scientific problem solving skills of middle school students. This Phase II research will be based on the Phase I results which identified the technical, logistical and professional development challenges that influence the rapid calculation, aggregation and real-time, online, reporting of problem solving assessment data to diverse educational stakeholders. The research will first design and implement an Online Analytical Processing (OLAP) model for data analysis and reporting and incorporate these designs into a system scale-up plan to flexibly accommodate the 10-20 fold increase in users indicated by our commercialization plan. A central component of this development will be a data warehouse that will be instrumented allowing the analysis of how teachers access the performance data, which will be linked to a digital dashboard which will provide teachers with an easy, and highly visual access to multi-dimensional assessments of their students and comparison classrooms. Additionally, this information will be used to develop new forms of professional development to support teachers in the better use of the data available.

The impact of this extensible formative, summative and programmatic assessment system of learning will have broad relevance for helping teachers to teach, students to learn, and administrators to make informed data-driven decisions through the continual, and real-time formative evaluation of a student's problem solving progress, a dimension not frequently or rigorously assessed in today's classrooms, yet a critical component of 21st century skills. The outcomes of this project should have widespread utility at all levels of science education and should allow cumulative comparisons of problem solving across science domains, classrooms, teachers and school systems thus helping to re-think the ways scientific problem solving is systemically assessed and how the impact of teaching these skills becomes quantified.

Urban Interactions Inc / GigBin.com

Phase II Award No.: 0956817

Award Amount: $500,000.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Sector: Education Applications

SBIR Phase II: Automated Mining of Worker and HR Preferences for On-Demand Job Matching

This Small Business Innovation Research (SBIR) Phase II project aims to improve the quality of on-demand job matching by applying data mining and machine learning techniques to natural language descriptions of job requests, worker reviews, and transaction history. The project will enable lasting job matches by predicting the needs, preferences and constraints of workers and human resource managers. Currently available methods of job matching rely primarily on keyword search, corporate personality assessment tests, or fixed ontologies. Such systems lack comprehensive learning and therefore have difficulty matching workers with jobs. This project approaches job matching with a bias-free learning model that learns from hiring successes, trains on real-world data, and adapts to new job verticals.

The broader/commercial impact of the project is a matching technology that optimizes workers' and employers' strengths, discovering matching opportunities overlooked by traditional search technologies. Online reputation-building through performance reviews can improve workers' ability to market themselves. The global matching technology permits nearly every skill to become marketable by matching workers with all features from every available job request. Natural language processing techniques, developed in the course of this project, have the potential to broaden the appeal of cell phone text-messaging as a comprehensive job-searching tool. Furthermore, the contextual approach to learning about workers and employers enables trends to be identified among users, and has far-reaching commercial implications in fields as diverse as medical research and e-commerce.

VCOM3D, INC.

Phase II Award No.: 0823070
Phase IIB Award No.: 1068211

Award Amount: $1,128,088.00

Start Date: December 15, 2008
End Date: November 30, 2013

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Sector: Education Applications

SBIR Phase II: Life-like, Expressive Avatars for the Instruction of Young Learners who are Deaf

This Small Business Innovation Research (SBIR) Phase II research project will develop a new authoring tool that will allow persons proficient in American Sign Language (ASL) to create animated stories and instructional material in ASL. The goals of this authoring tool are: 1) to support the creation of instructional materials that assist Deaf and Hard-of-Hearing (HH) students in the elementary and middle grades in learning to read; 2) to support the creation of animated ASL stories, including the full range of ASL grammar, that can be enjoyed by Deaf and Hard-of-Hearing students; and 3) to provide a tool that can be used by older students, at the secondary and university levels, to learn about the ASL by creating animated ASL passages.

The project includes the development and testing of exemplary reading instruction for Deaf students reading at grade level K-6. The research will result in improved, computer-based reading instruction for the 50,000+ K-12 Deaf/HH students in the U.S. whose first language is ASL, as well as students that are taking ASL courses. Currently, Deaf children are delayed in developing language skills, to the extent that the average reading level of a Deaf high school graduate is no greater than 4th grade. Since Deaf children have difficulty developing phonemic awareness, and are often isolated from contextual information available to hearing students, teaching reading to Deaf children requires the application of several unique methods that go far beyond simply translating English text. By providing educators and developers of educational software with products that allow them to develop personalized signing avatar tutors for Deaf children, this project will make possible the creation of instruction that is available 'anytime, anywhere' for assisting Deaf children in developing literacy skills.

ZIENON, LLC

Phase II Award No.: 0924574

Award Amount: $500,000.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Education Applications

SBIR Phase II: Tapping Finger Identification for Efficient Mobile Input

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to further develop the Tapping Finger Identification (TFI) technology investigated in Phase I. As mobile devices become more powerful and ubiquitous, text entry remains a major bottleneck to the wider adoption of mobile computing. To address this urgent need in lack of an acceptable solution, this TFI technology enables high-speed input in mobile devices and gaming applications using conventional typing techniques and keyboard layouts. In addition to demonstrating the feasibility of TFI during Phase I, the project will develop an IP strategy and a set of tools essential to future research and development. To date, one prototype has been implemented and a license agreement to commercialize some portion of the TFI technology was reached with an external partner. Completion of the Phase II research in two years will pave the way for commercialization of this innovative technology as we transition toward mobile computing. The technology developed could potentially impact a broad range of application areas, including mobile computing, gaming, military, and mobile security.

Mobile devices are becoming more powerful and ubiquitous. According to the IDC, convergent mobile devices grew 51% in 2007, and will grow from 124 million to 376 million in 2012. Data entry, however, remains a major bottleneck to the wider adoption of mobile computing. Most users are frustrated with existing input methods on portable devices, such as phones and mobile PCs. Much less a paragraph of text, simply entering a website's URL in a phone or mobile PC would be a burden for many. To address this urgent need in lack of an acceptable solution, the outcomes of this project projects the enablement of high speed, efficient mobile input using conventional typing techniques and keyboard layouts.

ELECTRONICS, INFORMATION & COMMUNICATIONS TECHNOLOGIES

ELECTRONIC COMPONENTS & DEVICES

ELECTRONIC SYSTEMS & INSTRUMENTS

IT APPLICATIONS

3DeWitt LLC

Phase II Award No.: 0724428
Phase IIB Award No.: 1105887

Award Amount: $606,917.00

Start Date: September 1, 2007
End Date: February 29, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Three-Dimensional Microscopy of Surfaces by Grazing Incidence Diffraction

This Small Business Innovation Research (SBIR) Phase-II project is aimed at building a working three-dimensional microscope for industrial applications. This patented optics using holography will be grafted onto a two- dimensional inspection microscope now sold into the thread spinneret manufacturing industry. This research will seek to demonstrate that the expensive holographic master used in Phase I can be inexpensively mass replicated. Optical microscopy has almost always used refractive primary objectives, and 3D versions of classical refractive microscopes exploit the methods of triangulation, confocal focus accommodation, or interferometry. Here, a new concept into the technology of optical microscopy, primary objective gratings, is introduced. We have demonstrated that if an objective grating is fabricated using holography and is then configured at grazing incidence, it can be used as 3D profilometer. The demonstration microscope will be designed with features to show that it can be sold into the electronics surface mount technology inspection industry, a larger market than spinneret inspection.

This project will demonstrate the 3D capability to inspect solder paste and component insertions of sample circuit boards, and therefore will impact industrial inspection, and will provide robust field units for geology, archeology, anthropology, and paleontology. In medicine, this method has utility in endoscopy, and uses in surgery and dentistry is also foreseen. Generalized biological scientists will also be end users with the introduction of computer image processing, the availability of 3D profiles greatly expedites characterization and pattern recognition, because 3D data is immune to variations in surface shading typical of 2D image processing.

ANTEOS, INC.

Phase II Award No.: 0923706

Award Amount: $361,416.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: Relief-Free Infrared Diffractive Optics Based on Semiconductor Materials

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop a new generation of relief-free thin-plate components of diffractive optics operating in the infrared region of spectrum. The diffractive optics employs volume phase holographic structures, which are optically recorded in semiconductor materials transparent at the infrared wavelengths using proprietary process of photo-modification for producing dramatic change of the material refractive index under illumination with low intensity light. Phase I of this project proved feasibility of the proposed concept by demonstrating photo modification of ZnSe infrared material and fabricating the first model components. The developed technology can be immediately applied to fabrication of diffractive optics, volume phase holographic gratings, and phase retardation plates for wavelengths up to 1.9 ìm, as well as antireflection layers for wavelengths up to 8 ìm. In Phase II project the technology will be optimized and applied to fabrication of the prototype components of infrared diffractive optics operating at longer wavelengths, including the important wavelength of CO2 laser 10.6 ìm and windows of atmospheric transparency 3-5 and 8-12 ìm.

The developed photo-modification process is highly adaptable and creates a rich technology platform for fabrication of a broad range of products for a large variety of markets. Successful implementation of this technology will result in a new generation of high efficiency relief-free infrared diffractive optics and sub-wavelength components, including diffraction gratings, beam splitters, beam shapers, semiconductor materials with artificial birefringence, phase retardation plates and wave plates. The relief-free components of infrared diffractive optics based on semiconductor materials are capable to withstand high light intensities and perform complicated light management functions. Another important application is the fabrication of highly stable anti-reflection (AR) layers on infrared semiconductor optics. The market for infrared diffractive optics includes defense and airspace industry, laser industry, spectral devices, sensors and detectors, night vision optics, industrial process control, material processing, cutting and welding, environmental monitoring, medical diagnostics and surgery.

Arete Associates

Phase II Award No.: 0956879

Award Amount: $499,988.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Affordable Optically Pumped Semiconductor Lasers for Polychromatic Guide Star Systems

This Small Business Innovation Research (SBIR) Phase II project conducts research and development of a unique laser technology that simultaneously provides a compact and low-cost alternative to laser guide star and polychromatic laser guide star sources. Guide star lasers are used in ground based adaptive-optics telescopes to provide high altitude, bright, point sources enabling adaptive near real-time correction for atmospheric aberrations. Adaptive optics systems rely on a combination of laser and natural guide-stars for tip-tilt correction. This limitation reduces the regions of space that can be explored due to the scarcity of natural guide-stars of adequate brightness. An elegant solution is to use polychromatic laser beacons comprising two closely spaced output wavelengths (569 and 589nm) to produce guide stars emitting, at distinctly disparate wavelengths (330 and 589nm). In 2008 a National Science Foundation committee of key adaptive optics scientists and decisions makers found astronomy is limited by the current state-of-the-art in lasers and that improving sodium laser beacons is critical to reaching stated astronomy science objectives. The research conducted under this SBIR project will produce optically pumped semiconductor lasers that can overcome technical limitations presented by more traditional guide star laser alternatives while simultaneously making guide star lasers more affordable.

The broader impact/commercial potential of this project will significantly impact the ability of observatories around the world to reach their scientific objectives by making available highly-reliable, low-cost guide star lasers. Currently, laser guide star systems are too expensive for all but the most well endowed observatories. Renowned experts and key decision makers in the field estimate the current laser guide star system cost at $100,000 per Watt of output power. The use of the laser technology to be produced can dramatically reduce the cost while simultaneously reducing the size weight and power required to operate the laser. In the near future, astronomical observatories will develop and field telescopes with much larger apertures. These and existing large aperture telescopes require multiple guide star lasers with a higher level of diversity, greater reliability while having lower per unit acquisition and maintenance costs. Successful development of the proposed product will positively impact astronomy, science and education by freeing up resources otherwise allocated to acquisition of expensive guide star systems. As a result, smaller observatories requiring a single system and large observatories requiring multiple laser guide stars will be able to execute their capital acquisition plans and achieve their science goals more rapidly.

BOSSA NOVA TECHNOLOGIES LLC

Phase II Award No.: 1026525

Award Amount: $498,184.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: High Dynamic, Alignment Free Metrological Method for 3D Shape Measurement of Optical Surfaces Based on Polarization

This Small Business Innovation Research (SBIR) Phase II proposal aims at developing a new alignment-free metrological turn-key system dedicated to the measurement of optical surfaces with high measurement speed and high dynamic range. Next generation optical surfaces will need to be mass-produced with high departure from spherical shapes and high numerical aperture (Aspheric). Manufacturing these optical components is challenging because of today's limited metrology methods: contact sensors are too slow to be used in-process whereas interferometers and wavefront sensors have a small limited dynamic range and require careful alignment. The research objective is to design a prototype of a polarization based method and to evaluate its performances; speed, dynamic range, accuracy, insensitivity to alignment. The proposed approach combines an innovative polarization camera, a specific illumination, and a novel algorithm for automatic 3D shape extraction. The result of this research is to demonstrate that the proposed approach leads to very low sensitivity to alignment, fast measurement time, high dynamic range, and uncertainty smaller than current manufacturing tolerances. Preliminary simulations show that 2" diameter aspheric lens can be measured in 40 ms, with a resolution of 10,000 points, a dynamic range of 20 mm and an accuracy of 0.25 micron root-mean-square (RMS).

The broader impact/commercial potential of this project will address the growing manufacturing of aspheric optical components used for various applications: concentrating photovoltaics (CPV) for solar power generation, optical instruments, ophthalmic lenses and consumer electronics (cameras, phones). Controlling aspheric optical surfaces using current metrology tools is a time consuming process. Contact sensors are too slow and interferometers have tight alignment requirements and low dynamic range. The commercial potential of a system insensitive to alignment, performing fast measurements, with high dynamic range and good accuracy is extremely valuable for the following reasons. The system would allow mass production of high quality aspheric lenses with systematic inspection of each manufactured component. High numerical aperture lenses would also be measured easily in-process which will drastically increase productivity. This will translate into the faster deployment of cheaper, more efficient solar power production, lighter optical systems, and better corrected contact lenses. The present project will also have the broader impact of opening the door to a new kind of metrology based on polarization sensing, which could also be applied to many other industries such as plastics, steel, glass, automotive, robotics, surveillance and medical industries in the future.

Boston Microsystems Inc.

Phase II Award No.: 0956381

Award Amount: $526,000.00

Start Date: March 1, 2010
End Date: February 29, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Fast-Response, High Sensitivity MEMS based NOx Emission Sensor

This Small Business Innovation Research (SBIR) Phase II project will develop a nitrogen oxide (NOx) sensor for diesel engine and other lean-burn combustion systems. This innovation combines unique SiC-based piezoelectric bimorph microresonator chemical detection technology with NOx sensitive materials, to develop an emissions control NOx sensor capable of operating in harsh engine emissions environments. The feasibility of the NOx sensor was demonstrated in Phase I by assembling a preliminary prototype, testing it in environments characteristic of hot engine emissions, and demonstrating 1 ppm NOx detection with 1 second response times and stable operation at 400?aC. The Phase II research objectives are to refine the sensor, including the bimorph resonator, NOx sensitive coatings, packaging and control electronics, to achieve higher temperature operation, 5 year lifetime, and reliable detection of 1 ppm NOx in the presence of varying concentrations of other exhaust gases. Extensive stability and life testing will be performed to identify and address potential degradation mechanisms such as poisoning, fouling, carbon deposition and materials inter diffusion. The prototype, including integrated heater, temperature sensor, control electronics and power/ data interface, will be operated in engine test stands to demonstrate performance in actual exhaust environments.

The broader impact/commercial potential of this project lies in its ability to accelerate the adoption and use of automobiles that use clean diesel and renewable diesel fuels, which is a low-risk and high-impact way of reducing both polluting emissions and US dependency on foreign energy supplies. Diesel engines typically produce up to 20% less greenhouse gas emissions than a comparable gasoline powered vehicle. However, they also produce a significantly higher amount of nitrogen oxides (NOx), a pollutant that causes smog and acid rain. Although the technology exists to treat and eliminate this NOx pollution, it requires a high temperature compatible sensor with sensitivity and response time that does not exist commercially today. This NSF SBIR Phase II program will develop a NOx sensor capable of meeting the needs of the automotive industry for a diesel engine emissions sensor for both real-time on-board diagnostics and emissions reduction, bringing vehicles into compliance with new environmental regulations coming into effect in 2013. Enabling the wider adoption of clean diesel engines will reduce both greenhouse gas emissions and dependency on petroleum, as consumers increasingly choose these greener and more cost-effective vehicles.

Bridger Photonics, Inc

Phase II Award No.: 1058583

Award Amount: $499,996.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Fast and Accurate Laser Distance Metrology

This Small Business Innovation Research (SBIR) Phase II project will enhance and optimize the Precision Distance Measurement system developed during the Phase I effort. The technology is based on innovative ultra-precise control of frequency-swept lasers to determine absolute object distances and thicknesses. The system is capable of distance and thickness measurements with <10-nanometer precisions, >1 kHz update rates, volume measurement coverage of 1 m3 (<10-micron precision), and measurement ranges >>1 meter. This combination of features is needed for industrial metrology, target identification, and precision surveying applications. During the Phase II effort, a prototype system will be constructed and used to perform targeted experiments based on identified OEM customer needs and industry technology gaps. The prototype will include Doppler compensation, a software interface, and will be fully configured and tested for both in-house and on-site testing. The prototype will then be used to perform critical in-house and on-site demonstrations driven by OEM customer needs, which include spatial multiplexing and galvo steering for rendering rapid 3D images, precise measurement of large-angle and diffusely scattering surfaces for precise measurement of aspheric lenses, oddly shaped objects, and rough surfaces, and precise measurement of meter-level displacements for CMM and gauge block calibration.

The broader impact/commercial potential of this project will initially be to improve manufacturing efficiency, quality, and production throughput. The measurement system uniquely combines extremely high precision (<10 nm) with the ability to measure over extremely large ranges (>>1 m). Due to this combination of performance and flexibility, coupled with demonstrated high update rates, the technology will enable increased production throughput in the manufacturing process and enable rapid absolute positioning and scanning measurements. The system will therefore enable considerable growth in an industry driven by advanced and more accurate inspection. The project will also lead to important societal benefits. For example, the technology holds promise for penetration into severely degraded visual environments caused by blowing sand and dust as well as into smoke or fog. It is anticipated that a variety of military and civilian applications would benefit from this capability including navigation, fire safety, and inspection systems. The benefits include saved lives and reduced property damage and more efficient search and rescue in burning buildings. Moreover, the system provides unique scientific opportunities such as enabling advanced space-based measurements by formation flying sparse apertures for the exploration of extra-solar planets and for atmospheric turbulence mitigation and high resolution imaging of the earth from space.

Enervana Technologies LLC

Phase II Award No.: 1058523

Award Amount: $499,380.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Metal-based microchannel heat exchanger systems

This SBIR Phase II project aims to develop a compact, metal-based, recirculating liquid cooling system for next-generation electronic devices. The dramatic increase in computing power over several decades has been accompanied by an equally dramatic increase in the heat generated at the electronic module level. It is generally accepted that forced air cooling, the dominant cooling technology of today, will not be sufficient for high performance devices of tomorrow. Alternative cooling technologies with higher performance and lower area/volume footprint have become critical for better-performing computing devices. A significant market is expected for such advanced chip cooling technologies. Metal-based microchannel heat exchangers (MHEs) combine high heat flux removal capacity, low area/volume footprint, as well as high mechanical integrity, and constitute a leading technological contender for replacing forced air cooling. This project will focus on design and fabrication of metal-based MHEs and MHE assemblies as heat absorption and rejection modules with improved heat transfer performance, assembly of recirculating-liquid MHE systems, and benchmarking against competing technologies. The study on the design, fabrication, and heat transfer testing of metal-based MHEs will enhance scientific and technological understanding related to micromanufacturing, as well as microchannel liquid flow and heat transfer.

The commercial potential of this project is tied into the ultimate project goal of incorporating liquid-based chip cooling technology with the best performance into next-generation desktop personal computers and other microelectronic and powerelectronic devices. The planned recirculating-liquid MHE chip cooling system is envisioned to become a critical enabler of higher performance and higher power electronic devices. A quick review of the progress in computing devices over the last few decades and the associated societal changes serves to convince that increased computing power in the hands of imaginative people can unleash unforeseen innovations. Successful execution of this project will push to the market place a product that can serve a catalytic role in such an innovation unleashing process. The target product will be marketed to computer original equipment manufacturers and is shown to enjoy performance and cost advantages over competing devices currently being contemplated. The project goal is to develop cost-effective manufacturing technologies to the point of production readiness. Successful execution of this project will help to establish the commercial viability of a technology-based manufacturing company with potential for positive economic impact and job creation.

Fairfield Crystal Technology, LLC

Phase II Award No.: 1026380

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: A Novel Approach for Production of Freestanding GaN Wafers for III-Nitride Light Emitters and Detectors

This Small Business Innovation Research (SBIR) Phase II project is to demonstrate a novel technique for producing large-diameter freestanding GaN wafers and substrates. Despite the research efforts in the last decade, affordable GaN wafers and substrates of large diameters have not been widely available commercially, which hinders commercialization of high performance GaN-based devices. This Phase II project will demonstrate a unique approach to growth of GaN thick films and fabrication of freestanding GaN wafers and substrates with low densities of dislocations and low wafer bow/warp in an efficient manner. This Phase II research includes crystal growth of GaN thick films, fabrication of GaN wafers and substrates, and extensive characterization of GaN wafers. If this Phase II project is successful, high-quality freestanding GaN substrates of large diameters will become widely available commercially at an affordable price, which will enable volume production and commercialization of high-performance GaN-based light emitters and ultraviolet light detectors.

The broader impact/commercial potential of this project is in the areas of GaN-based light emitting diodes (LEDs), lasers, and ultraviolet (UV) light detectors. GaN-based blue and green high brightness LEDs hold a great promise for solid-state lighting applications because of their tremendous energy savings potential, long lifetime, compactness, and high energy efficiency. Solid-sate lighting will dramatically improve the nation's energy sustainability in the near future. In addition, freestanding GaN substrates are also needed for fabrication of variety of other high-performance semiconductor devices, such as blue laser diodes for data storage/displays, UV LEDs for water/air purification, high-power RF devices for wireless communication, high-power switching devices for harnessing renewable energies (e.g. wind, solar), and UV detectors for detection/analysis of chemical and biological agents for homeland security applications. Finally, this project will help create jobs in business sectors of energy conservation and renewable energies, and will increase competitiveness of US companies in these business sectors.

Gamma Dynamics LLC

Phase II Award No.: 1058302

Award Amount: $499,977.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Bistable Electrofluidic Device for High-Brightness Electronic Paper

This Small Business Innovation Research (SBIR) Phase II project will create electronic paper displays from a new e-paper technology that promises substantially improved black and white contrast, bright color images, multimedia/internet update speeds, and zero power image hold. The technology, an electrofluidic pixel that uses voltage to move a colored pigment in a fluid, is capable of achieving twice the reflectivity of existing e-paper solutions. This improvement in reflectivity enables the color saturation found in printed media. The multi-stable pixel designs demonstrated in the Phase I program make possible zero power images with grayscales. The Phase II research project will develop the technology for complete electronic paper displays incorporating this new pixel technology that are robust and manufacturable, and that achieve record reflectance (~ 70%). The first prototypes to be designed and created will be simple information content displays with simple electrical drive, such as electronic shelf labels. The later stage prototypes will be e-Reader displays with active matrix backplanes.

The broader impact/commercial potential of this project is the widespread replacement of paper-media with electronic paper, providing superior low power products to the current burgeoning market. In particular, the improvements demonstrated in this project enable saturated colors and multimedia "video" rates with a zero-power image hold, thereby overcoming performance barriers that have blocked low power color electronic books from entering the market. For example, this technology could replace a stack of textbooks with a single lightweight color multimedia tablet. The market opportunity is easily in excess of $10B, and will support numerous new U.S. jobs under a business model providing a sustainable economic benefit to the U.S.A. Multi-stable electrofluidic technology is also well suited for both small and large electronic signage applications.

Imaging Systems Technology Inc.

Phase II Award No.: 0750267
Phase IIB Award No.: 1001282

Award Amount: $1,012,000.00

Start Date: April 1, 2008
End Date: September 30, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Fabrication of Luminescent Phosphor Plasma-sphere Arrays for Display Applications

This Small Business Innovation Research (SBIR) II project will develop hermetic hollow gas encapsulating spheres (Plasma-spheres) with shells fabricated from phosphor compositions processed with modified processing methods. The outcome will be blue emitting Plasma-spheres and improve red and green Plasma-spheres for use in a full color flexible plasma display. Plasma-spheres are placed on flexible electrically addressable arrays with the ionized gas glowing when a voltage is applied across the Plasma-spheres. This is due to the conversion of UV into visible light.

If successful this process will allow carpet size displays to be produced at a fraction of the cost of rigid glass displays. Unlike traditional one-piece rigid plasma display technology, the Plasma-sphere pixels are produced separately and applied to large flexible electrically addressable substrates using low cost wide-web processes. The separation of pixel production from substrate fabrication provides several advantages; 1) shortened cycle time (by eliminating a 19 hour gas processing step), 2) higher yields, 3) lower capital equipment investment, 4) lower production costs, 5) longer life, 6) smaller form factor, and 7) a greater percentage of biodegradable material. The entire Plasma-sphere array production process is environmentally benign.

Imaging Systems Technology Inc.

Phase II Award No.: 0956629

Award Amount: $499,995.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Sector: Electronic Components and Devices

STTR Phase II: Improved Addressing Speed of Plasma-sphere Arrays

This Small Business Technology Transfer (STTR) Phase II project is a study to expand the high speed addressing work conducted under Phase I using monochrome Plasma-spheres to color Plasma-spheres. Plasma-spheres are hollow transparent shells that encapsulate a selected pressurized gas. When a voltage is applied across the shell, the gas ionizes and glows. Plasma-spheres are applied to flexible, electrically addressable arrays to form Plasma-sphere arrays for use as large area plasma displays. Plasma-sphere arrays, like standard plasma displays require secondary electron emitting materials to increases addressing speeds. Under Phase II, the team will continue to investigate both thin film and thick film techniques for applying these materials to color Plasma-spheres. The proposed research presents a novel approach to produce video speed large area plasma displays. The Plasma-sphere array differs from other display technologies in that it allows for low-cost displays that are flexible, ultra-large, with full-color and full motion video.

The broader impact/commercial potential of this project is a breakthrough display technology. It moves away from the traditional semiconductor fabrication processes as practiced by many display manufacturers in Asia and replaces them with low cost plastic, glass, and printing processes practiced and well understood by US based companies. The successful development of a high speed addressing will help move this product toward commercialization in the large and growing market of dynamic signage. Commercialization of this technology will lead to job creation and commercial opportunities in the United States. Furthermore, Plasma-sphere arrays are an order of magnitude lower in production cost when compared with ultra large LED displays. Lower material and manufacturing costs provide a social benefit in that fewer natural resources are required with a less taxing effect on the environment. The Plasmasphere array can be made large like an LED display, while retaining many of the exceptional features of a conventional, rigid plasma display including good viewing angle, high brightness, excellent contrast, and full motion video.

Innovega Inc.

Phase II Award No.: 1057840

Award Amount: $485,599.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Optic-On-Eye Virtual Reality Display

This Small Business Innovation Research (SBIR) Phase II project will extend the development of the contact-lens-enabled virtual reality display system demonstrated in Phase I. A key goal will be to advance the construction of the contact lenses to be ready for commercial market tests and OEM partner evaluations. Although the Phase I devices are fully functional and have validated the analytical predictions, they are not yet suitable for commercialization. The main deficiencies are the non-permeability of the polarization filter, the inadequacy of the joining adhesive, and the immaturity of the manufacturing processes. This project plans to develop a highly gas permeable polarizer using nano-imprinting onto gas permeable polymers. In addition, the contact lens construction techniques will be advanced in order to improve optical performance. A further goal is to develop prototype stereographic video eyewear to be used together with the contact lenses in support of clinical evaluations. Lastly, an IRB protocol will be developed and the contact lenses will be put through clinical trials. It is anticipated that all-day-wear contact lenses can be produced that will be able to meet FDA approval, and the performance advantages of this new display system can be evaluated during formal clinical tests.

The broader impact/commercial potential of this project will be a significant improvement in how mobile and immersive imagery is viewed. Today, mobile computing devices must present their information through small LCD panels, while immersive computing must settle for the limited fields of view available through flat panel monitors and TVs. Wearable electronic eyewear are available today that attempt to address these limitations, but they themselves suffer from limited fields of view and excess bulk. This SBIR research will address the remaining unresolved technical challenges in order to prepare this new display concept for commercialization. If successful, a meaningful enhancement of human vision will have been achieved by making it possible to directly view very near objects without impacting normal distance vision. These advancements will enable many new applications for wearable displays including augmented reality, highly immersive 3-D video, stylish mobile display eyewear, wearable surgical imaging devices, and even comfortable high quality electronic low vision aids for sufferers of macular degeneration and other vision disorders. Because mobile devices and home computers are so ubiquitous in our modern societies, the anticipated benefits of improving the man/machine interface through high quality virtual imagery eyewear should impact numerous markets and demographics.

ISCA Technologies, Inc.

Phase II Award No.: 0823095
Phase IIB Award No.: 1105107 (Pending)

Award Amount: $448,148.00

Start Date: December 15, 2008
End Date: May 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: Autonomous Sensor Network to Manage West Nile Virus Epidemic

This Small Business Innovation Research (SBIR) Phase II proposal seeks to develop an automated sensory system (AMSS) for gathering and processing of mosquitoes vectors of West-Nile-Virus-Fever (WNV). AMSS captures mosquitoes, macerates them with solvents, process the fluid using a sensory array, relays wirelessly the information to a centralized internet hub where data is hosted, managed, reports created and distributed. There are four main parts to the proposed AMSS: 1) Design and development of the robotic device that sucks and crushes the insect; 2) Design and development of the sensor array; 3) Development of methods to determine presence of WNV in the circulatory fluids of the insects; 4) Automated wireless system for transmitting data. The AMSS can also be decoupled from the mosquito-trap providing the user with a handheld-sensing-system to detect WNV in samples derived from vectors (e.g. mosquitoes) or hosts (e.g. humans, vertebrates in general). The proposed system can be potentially expanded for detecting other harmful pathogens and could be used by homeland security and public health agencies.

If successful detection of the WNV-pathogen at a very early stage of its occurrence is of significant benefit to public health agencies and may allow for diversion of future epidemics. Early detection is the only form of early epidemic prevention. This project describes a disruptive concept to fill an enormous gap in vector-management, which now lacks technologies for speedy and effective data collection. WNV-detection-instruments are slow, expensive, bulky, require human interference and laboratory conditions with plenty of consumables and energy, and not amenable to unattended autonomous operation. Current detection procedures invariably fail to detect introduced pathogens before disease or epidemics become widespread. Vector-control personnel and epidemiologists rely on manual time consuming mosquito- vector management methods that often come too late to prevent epidemics and require expensive remedial actions, such as blanket spraying of insecticides on entire regions. Such mosquito management is inefficient, ecologically harmful and conducive to pesticide resistance. The proposed AMSS system will have significant impact in the detection of WNV-pathogens market, evaluated at $500M/yr. This will foster preventative rather than crisis or partially effective, remedial control actions. Implications can be made that this vector and disease management may be useful for bio-detection in the homeland-security, health-care, agroenvironmental field and food-safety markets, evaluated at $1.3B/yr.

LC Vision, LLC

Phase II Award No.: 0924709

Award Amount: $515,981.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Electronic Components and Devices

STTR Phase II: Ferroelectric Liquid Crystal (FLC) Gels for Facile Processing and High Yield Manufacture of Hardened FLC Displays

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project will enable the widespread use of ferroelectric liquid crystal (FLC) electro-optic devices, leading to a new generation of displays that have greater speed, higher resolution and lower power consumption than today's liquid crystals displays (LCDs), which use nematic LCs. A proprietary family of additives, "polymer dopants" demonstrated in Phase I, overcomes the main technical obstacles to large-scale application of FLC devices: manufacturing and stabilizing properly aligned cells. The proposed work will develop FLC-polymer materials that expedite processing and increase the yield of well-aligned FLC cells. In Phase I the team: 1) Identified side-group liquid crystal polymers that dissolve in FLC. , 2) Showed that the FLC-polymer mixtures retain fast electro-optic (EO) responses3) Demonstrated that the FLC-polymer mixtures robustly and rapidly adopt the proper alignment, giving bistable switching that is elusive in the FLC alone. In Phase II the team will establish the structure-activity relationships for polymer dopants. It will optimize the FLC-polymer mixtures to establish reliable processes to produce well aligned FLC cells in high yield at high production rates.

Approximately 2x109 small flat panel displays are used annually in cell phones, PDAs, iPods, etc. Currently, nematic LCDs overwhelmingly dominate this market $20 billion/year in LCDs, manufactured using $350 million/year of LC materials. The additives developed in this project will allow FLCs to be processed into displays in this size range, providing a step-change in resolution and speed in LCDs. This will lay the foundation for moving FLCs into LCD TVs ($86.3 billion/year market in 2008, growing rapidly). Enabling commercial production of FLC displays 10 cm and up could revolutionize display technology and potentially fuel the growth of display manufacturers in the U.S. Scientifically, solutions of polymers in FLCs represent a nascent class of materials that has hardly been explored. This project is at the cutting edge of experimental research in LCs, providing the first glimpse into the consequences of orientational coupling in chiral smectic LCs.

Mezmeriz, Inc.

Phase II Award No.: 1058405

Award Amount: $499,662.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Next Generation Displays Based on Novel Carbon Fiber MEMS Micromirrors

This Small Business Innovation Research (SBIR) Phase II project is aimed at overcoming the small screen size limitations of mobile devices. The use of projection technology based on microelectromechanical systems (MEMS) micromirrors capable of scanning laser beams onto surfaces embedded within these devices offers a potential solution to the screen size problem. The end-goal of this project is the development of a tiny, energy efficient, low-cost, embeddable projection system capable of projecting large, high-resolution images at short distances from mobile devices. This effort will build off of work done in the Phase I project, in which a lab-scale functional prototype (a functional prototype has functionality but not scale or form-factor) of the system was built. This proposed effort will consist of two major research thrusts that are critical to the technology's success 1) Development of an illumination module with integrated intensity modulator, and 2) Development of an advanced, miniaturized, pico-projector prototype.

The broader impact/commercial potential of this project includes improving technology in the mobile device field. Business users and consumers are increasingly relying on the convenience of mobile devices as computing power and communication bandwidth improves. This market sector is increasing rapidly, and wireless mobile devices such as smart phones and netbooks are primary devices for computing and Internet access. However, the limitations of a sub-5" diagonal display have prevented mobile devices from achieving their full potential. The demand for ever smaller wireless devices (as witnessed by subsequent generations of the iPod) and the need for more screen real estate are in direct conflict. The capability of pico projectors to overcome screen-size limitations in mobile electronics devices, projecting a large image despite their small size, makes embedded pico projectors a perfect fit for space-constrained mobile devices. Through their ability to enlarge displays, embedded pico projectors can unlock the potential of the mobile device and make them more capable as primary computing and Internet-access platforms. This capability ensures this proposed technology will have high commercial demand for the extended future.

MYTEK, LLC

Phase II Award No.: 0823022

Award Amount: $627,930.00

Start Date: August 1, 2008
End Date: July 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Extended Performance Red VCSELs

This Small Business Innovation Research (SBIR) Phase II project will demonstrate significantly improved output power, temperature range of operation, and reliability of red VCSELs. Commercialization of red VCSEL technology has been plagued by the limited temperature range and output power of the devices and unknown reliability characteristics. The Phase I project demonstrated the 1) feasibility of improving output power and temperature range through a number of techniques, 2) that the fundamental limit of the temperature range is at least as high as 125°C, and 3) dramatically improved reliability. The Phase II approach proposed here breaks away from traditional models for fabricating VCSELs and consists of a variety of growth and fabrication methods allowing us to provide a high thermal conductivity path from the active region to the package. The goals and expected technical results are to demonstrate > 0.5mW single mode, and >1mW multi-mode useful output power at 670nm at 85°C, and the same power output power objectives for 655nm at 65°C on a reproducible basis. This project will also demonstrate greater than 10,000 hours device lifetime at 85°C continuous operation. Project activities consist of design, wafer growth and fabrication, performance testing, and reliability testing.

To date, the only commercially available VCSELs have been at 780nm to 850nm, due to the substantial materials challenges at other wavelengths. This proposed effort is applicable to a variety of VCSEL wavelengths (similar thermal issues exist at 1310nm to 1550nm), as well as other optoelectronic devices. Commercially, a significant enhancement in red VCSEL performance can enable the migration of plastic fiber based home and auto networks to higher data rates, faster and higher quality laser printing, longer distance and more precise motion control sensing, new types of portable or wearable medical sensing, and improved robustness and cost of radiography equipment. The success of this project not only creates a significant business opportunity for a red VCSEL supplier, but also enhances the competitiveness of customers by making available a valuable new technology. The reduction in power consumption and improvement in medical technology costs address particularly important societal issues.

ONDAX INC.

Phase II Award No.: 0956430

Award Amount: $499,943.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Self-Aligned Miniature External Cavity Tunable Laser from Blue-Violet to Infrared

This Small Business Innovation Research (SBIR) Phase II project focuses on the development, manufacturing and commercialization of a novel miniature self-aligned tunable diode laser. The tunable laser platform offers two major advantages compared to currently available products and technologies: (1) passive optical alignment and assembly; and (2) extremely broad spectral coverage from visible (375nm) to the infrared (4,000nm). The self-alignment feature translates to much simpler and efficient manufacturing, and the optical design enables the new platform to be two orders of magnitude more compact than commercially available tunable diode lasers. These features combine to considerably lower the labor costs associated with assembly and packaging. The research objectives are to determine the parameters of the passive cavity that enable (1) stable single frequency operation, (2) a linewidth less than 30KHz, and (3) less than 1MHz wavelength drift. It is also critical to develop methods to tune the output to a specific target wavelength. Prototypes of the tunable laser will be built for three wavelength groups: blue (400-415 nm), Red (635-660 nm) and near-infrared (760-790 nm). This novel laser platform will enable a broad range of technology areas.

The broader impact/commercial potential of this project has direct links to commercial applications that decrease energy use or promote renewable energy implementation. Specifically, this laser technology can assist the reduction of carbon emissions by monitoring and optimizing efficiencies in combustion processes such as engines and coal plants (via gas sensing with infrared tunable lasers). The technology will help accelerate the deployment of environmental sensing stations by providing the key optical source for sensing systems at a fraction of today's cost. A second role would be to provide athermal operation of lasers, which could significantly reduce the energy consumption in telecommunication systems by eliminating the requirement for cooling the lasers. A third application would be improving the efficiency of renewable wind power (via wind sensing with blue-violet lasers) by enabling "smart" wind turbines. A laser-based wind sensor would provide each "smart" turbine of a wind farm with the ability to preemptively assess and accurately predict the wind load far in advance, helping improve overall turbine efficiency and utilization. This information is critical to the planning of energy supply into the power grid. All of these applications have immediate commercial potential to help reduce the World's dependence on fossil fuels.

Paradigm Optics Incorporated

Phase II Award No.: 0923844

Award Amount: $499,970.00

Start Date: September 15, 2009
End Date: August 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: Next Generation Polymer Optical Fiber

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovative Research (SBIR) Phase II project will create innovations in the science and application of polymer doping, fiber drawing, and bundling technology. Research will be conducted to shrink fiber diameter limits to submicron dimensions, to dramatically reduce diameter fluctuations, to increase pixel density, to increase array size, to reduce manufacturing time, and to improve array quality. Experiments will be performed to develop novel methods of doping polymer with higher concentrations of quantum dots and other nanoparticles. Additionally, a ribbon array cutting machine and a microwell fabrication apparatus will be developed. The current glass-based fiber optic technology is expensive, has limited functionality, and cannot be used in some applications. The company's proposed polymer products will be better replacements for current glass products, not only because of lower fabrication costs, but because of the increased functionality polymers provide, as well.

The innovations from this Phase II program will have significant scientific, technological, and social benefits. For example, in the fields of biological investigations, genomic studies, new pharmaceutical development, and detection of biological agents, polymer fiber optic arrays will increase the efficiency and integrity of high speed analyses for high throughput parallel experimentation. This program will also advance scientific understanding of the dynamics of Qdot and nanopartical dopants in polymers, providing fundamental benefits to the scientific literature for nonlinear optical polymer dynamics, as well as new methods to exploit quantum phenomena in mesoscopic devices. The commercialization of cost-effective, reliable microstructured fibers provides equipment manufacturers a pathway to supply new products of high impact to medical, information technology, and retail markets.

ProSpect Photonics, Inc.

Phase II Award No.: 0956900

Award Amount: $500,000.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Components and Devices

STTR Phase II: An Ultra Compact and Low Cost Raman Analyzer Based on Slitless Volume Holographic Spectrometers

This Small Business Technology Transfer (STTR) Phase II project focuses on the commercialization of a new low-cost and compact low-resolution (~1 nm) Raman spectroscopy (LRRS) technique for medical diagnostics. Current Raman spectroscopy systems are bulky and expensive and have small throughput for diffuse light (e.g., Raman scattering), due to their front narrow slit. Handheld and low-cost LRRS systems are needed for medical diagnostics, specifically at less equipped point of care (POC) facilities. Besides, the small efficiency of the current systems make them use higher pump laser power and focus it onto the examined tissue that adds to the cost and can damage the tissue. The technology adopted in the proposed Raman analyzer is a holographic spectroscopy method that uses spherical and cylindrical beam volume holograms. The technology enables compact, light weight, and low-cost spectrometers with the fewest main elements compared to the conventional LRRS systems. Specifically, the narrow slit as in the conventional spectrometers is eliminated, whereby diffuse light can be more efficiently coupled in the spectrometer. The development of a LRRS system prototype with the mentioned volume holography technology is proposed. The developed LRRS system will be then optimized for medical diagnostics based on surface enhanced Raman spectroscopy (SERS).

The broader impact/commercial potential of this project will be over a broad range of applications in the fields of biochemistry, medicine, pharmaceuticals, industrial quality assurance, homeland security, mineralogy, and environmental sensing. The compact and low-cost nature of the proposed instrument makes it the perfect choice for handheld sensing devices that are of high current demand in several fields mentioned above. The entire US market volume that can be covered by this technology has been $2.6B in 2005, with a prospected 7% growth rate through 2010. The potential application of the proposed instrument in the field of medical diagnostics (e.g., in the use of SERS signals for the detection of cardiovascular diseases) will have a major impact on public health by reducing the suffering and death of people due to a variety of medical conditions. The handheld SERS reader can be adapted to other rapid diagnostic tests and many other diseases can be rapidly diagnosed at less equipped POC facilities with this technology.

ProSpect Photonics, Inc.

Phase II Award No.: 1026895

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Juan E. Figueroa

Sector: Electronic Components and Devices

SBIR Phase II: Slitless, compact, low-cost, and multichannel volume holographic spectrometers

This Small Business Innovation Research (SBIR) Phase II project focuses on the commercialization of multichannel holographic spectrometers featured large operating bandwidth and fine spectral resolution. The proposed research is to develop a new platform for spectrometers using multiplexed cylindrical beam volume holograms (MCBVHs) as dispersive elements. Due to its unique characteristic, the MCBVH enables the design of two-dimensional (2D) spatial-spectral output patterns to significantly enhance the functionality of holographic spectrometers. A significant improvement of the operating bandwidth can be achieved without sacrificing spectral resolution while keeping all merits of a compact, lightweight, low-cost, reliable, and alignment robust holographic spectrometer. With the proposed multichannel spectrometer, several species of interest can be detected at one shot even though their spectrums are distributed in a very large spectral bandwidth. Due to the design flexibility of volume holograms, this technology enables the design of spectrometers with custom functionalities. Breaking the resolution-bandwidth trade-off of the conventional spectrometers with a holographic system that does not increase the complexity of the final product is the major breakthrough expected from this project. The expected outcome of this project will be a simplest yet highly functional spectrometer that can be designed to perform for technically any given application criteria.

The broader impact/commercial potential of this project is to provide an enabling technology for spectral sensor systems which offer great utility to the life science and medical markets. For high throughput screening, it is desired to have multiple channels read simultaneously on a test containing multiple sample sites. For fluorescence based tests, multiple fluorophores need to be quantified requiring more spectral information. Maintaining good sensitivity is still required in these applications for low concentration detection at a low cost and size demanded by these markets. The proposed multichannel spectrometer based on MCBVHs will have a broad range of applications in the fields of biochemistry, medicine, pharmaceuticals, industrial quality assurance, homeland security, mineralogy, and environmental monitoring. Moreover, the compact and lightweight nature of the proposed spectrometer makes it a perfect choice for handheld sensing devices that are of high current demand in several fields as mentioned above. The entire US market volume that can be covered by this technology has been $2.6B in 2005, with a prospected 7% growth rate through 2010. The use of sophisticated volume holograms with 2D spatial-spectral output patterns is an important enabling technology that can impact the design of custom multi-purpose spectrometers/sensors beyond the proposed functionalities.

Raydiance Incorporated

Phase II Award No.: 1026762

Award Amount: $499,457.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Novel Amplification Technology as a Path to Practical Application of USP Technology

This Small Business Innovation Research (SBIR) Phase I project makes significant advances in the field of photonics by developing a cutting-edge performance, cost effective and compact ultrafast laser light amplifier. The amplifier is a key element in generating this compelling form of light for revolutionary materials processing capabilities. Ultrafast lasers enable athermal ablation of nearly any material with micron-scale precision. Historically, ultrafast lasers have been confined to bulky, optical breadboard systems ideal for academic environments but unsuitable for practical commercial applications owing to their ambient temperature sensitivity and tendency to drift out of alignment. The technology developed under this SBIR leverages novel laser amplifier glass material development to support a planar waveguide amplifier architecture. When combined with recent advances in fiber-optic ultrafast laser technology, the herein developed amplifier module will produce a high power, compact, and cost efficient ultrafast laser integrated system. In addition, the advances made in planar waveguides under this program have utility in compact, high performance long pulse and continuous wave lasers. The technology will advance the state of the art in photonics to yield cheap, efficient and rugged amplifier architectures which can be used in a variety of applications.

The broader impact/commercial potential of this project is to provide a pragmatic architecture for ultrafast lasers which enables discovery and the application of this light in the commercial marketplace. The inherent capability for the short bursts of light from ultrafast lasers to ablate any material- including novel glasses, noble metals, modern alloys, polymers, and other hard-to-machine materials - will create substantial value by enabling a new generation of manufacturing techniques, products and services, and the businesses to drive these innovations. As a salient example, ultrafast lasers are capable of cutting and shaping bio-absorbable polymers, such as poly(lactic-co-glycolic acid) (PLGA), now in development for the next generation of cardiovascular stents. These slowly dissolve in the human body in order to avoid complications from restenosis. PLGA is extraordinarily difficult to machine with conventional lasers due to melting or mechanical techniques due to loss of structural integrity. Other examples include precise, efficient cutting of organic light emitting diode (OLED) substrates and precision thin film removal for high efficiency, large area solar panels. This technology will broadly impact business processes in multiple industries by advancing manufacturing fidelity-to-design and by making obsolete the incumbent defect removal methods such as hot acid etching.

Sand 9, Inc.

Phase II Award No.: 1058078

Award Amount: $499,625.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Chip-Scale Micromechanical Gyroscope for Angular Roation Detection, Stability and Control

This Small Business Innovation Research (SBIR) Phase II project seeks to develop the next-generation chip-scale Micro-Electro-Mechanical Systems (MEMS) gyroscopes for use in wireless devices that now require unprecedented device performance with minimum possible footprint. For instance, inertial navigation and motion sensing in most cellular devices require gyroscopes with small size, high sensitivity and stability, low drift and low power consumption. Most MEMS gyroscopes used in consumer electronics and wireless devices do not yet meet all the criteria for large-scale deployment in the fastest growing segment of the market: handheld devices. Existing MEMS gyroscopes are fundamentally limited by their underlying technology - electrostatic actuation and detection of vibration and rotational amplitudes. For this research project, a new approach has been proposed to the engineering of MEMS gyroscopes that can detect 3-axis rotation with unprecedented sensitivity and stability with minimal footprint. The goals of the Phase II project are to (i) develop both 2-axis (x-y) and hybrid 3-axis (x-y, z) micromechanical gyroscopes; (ii) develop associated driving and sensing integrated circuits (IC); (iii) test and characterize the devices for optimal performance parameters; (iv) bond the IC wafer to the MEMS wafer with wafer-level packaging.

The broader impact/commercial potential of this project can lead to a revolution in the consumer wireless systems market with the standing promise of an integrated single-chip inertial sensor and timing device. Micromechanical gyroscopes have increasing relevance in inertial navigation systems and automotive applications. Beyond these applications which require devices with better sensitivity and stability, a host of new applications in consumer electronics have suddenly emerged. In particular, handheld devices such as cellular devices and GPS systems, and gaming consoles such as the Nintendo Wii now include miniature gyroscopes that must have extremely small footprint and consume very little power. The proposed approach lends itself to natural chip-scale integration with timing devices for future production of Timing and Inertial Motion-Sensing Units (TIMU), necessary for next generation inertial navigation. Another commercial impact will be on the chip manufacturing industry, as the integrated circuits (IC) wafers will be fabricated in the United States, in potentially high volumes. Sand 9 is involved in the proactive employment of women and minorities in its engineering team, towards its commitment to the creation of a diverse, next-generation workforce in the MEMS industry.

Shasta Crystals, Inc.

Phase II Award No.: 1026196

Award Amount: $493,883.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Low Cost High Quality Nonlinear Optical Crystals for Laser Light Sources for Miniature Projectors

This Small Business Innovation Research (SBIR) Phase II project will demonstrate how to reduce the cost of manufacturing magnesium-doped lithium niobate (Mg:LiNbO3) crystals by more than an order of magnitude. Frequency-doubling crystals, such as Mg:LiNbO3 can convert 1064-nm light from an infrared laser to 532-nm (green) light. However, LiNbO3 crystals made by the conventional Czochralski technique typically cost $800 each, presenting an economic challenge for consumer applications. The approach is to grow crystals by the laser heated pedestal growth method with a novel afterheater and to pole them in situ. Phase II, enables the development of manufacturing capability for these crystals at a rate of 100,000 crystals per year at a cost of less than $22 each. In Phase III, The manufacturing capacity will be increased to 1,000,000 crystals per year and the manufacturing costs reduced below $8. The proposed cost reduction will enable manufacturers of picoprojectors to increase the brightness of their products by integrating lasers as the light sources instead of LEDs. The technical objectives are to optimize the density of Mg:LiNbO3 ceramic feedstock rods, to increase the manufacturing throughput by optimizing manufacturing yield and automating the growth apparatus.

The broader impact/commercial potential of this project is to enhance scientific and technical understanding by demonstrating a) a novel method of growing crystals with lower cost, higher speeds, and greater purity, and b) a way to pole LiNbO3 crystals in situ at lower cost. The project will generate a strong economic impact because many types of handheld consumer electronics devices (cell phones, PDAs, iPods, game terminals, etc.) contain digital data that require visual displays. Picoprojectors can display the content of handheld devices in large formats, but their LED illumination sources can't generate images with enough brightness to satisfy customers. Laser illumination sources can solve the brightness problem, but lasers are too expensive, primarily because of the cost of the frequency doubling crystals. This project will reduce the cost of these crystals and may thereby enable the picoprojector industry to realize its optimistic growth scenario ($3.6 billion in sales in 2014) rather than its conservative growth scenario ($901 million in sales in 2014). An intern, a science student who is a member of an under-represented group in the nation's science and engineering enterprise, will be hired to assist with Phase II research.

Silicon Audio, LLC

Phase II Award No.: 1026893

Award Amount: $490,012.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: High Performance Directional MEMS Microphones for Communication Devices

This Small Business Innovation Research (SBIR) Phase II project will investigate a novel Micro-electro-mechanical systems (MEMS) microphone based on new design principles. By abandoning the design principles of traditional microphones (both MEMS and full-scale), a vastly superior acoustical design is being explored that has resulted in substantial improvements in fidelity and size reduction (15 dB signal to noise ration[SNR] improvement over existing commercial directional microphones, and roughly 100x smaller in volume). Furthermore, as demonstrated in Phase I, the microphones have an inherently directional response with the benefit of focusing on a speaker or event of interest while rejecting ambient background noise. These attributes make this innovation ideal for addressing an emerging need of high volume consumer communication device manufactures who are looking for acoustic sensing innovations with the unique combination of high performance + low manufacturing cost. The objective of this Phase II innovation is to continue prototyping efforts from Phase I to the point of pilot scale manufacture. This effort will entail finite element modeling and design optimization of the new device structure, fabrication of 2nd generation prototypes, and experimentation in collaboration with customers from several different microphone sectors including hearing aids and cellular phones.

The broader impact/commercial potential of this project is based on an enabling capability: the introduction of advanced audio features (e.g. directionality and high fidelity) into a suite of consumer communication devices. The primary customer focus for this innovation is high volume consumer communication device manufacturers. New applications on their horizon demand improvements in microphone component performance. There are presently several commercial suppliers of MEMS microphones. All use variations of a traditional microphone architecture which has proven incapable of addressing high SNR applications. Additional markets and applications for this innovation include acoustic instrumentation, performance audio, military and defense, intelligence gathering, speech recognition (e.g. in laptop computers), and hearing aids. Addressing hearing aid markets will have a societal impact as well, as patient satisfaction with hearing aid devices is presently very low. Innovations at the microphone and signal processing level have the potential to improve this greatly. The innovation is also expected to have other audiological applications including use in hearing health monitoring systems based on otoacoustic principles. Clinical tools and instruments based on this innovation will serve to enhance scientific and technological understanding in many fields of acoustics.

Spectral MD Inc.

Phase II Award No.: 1058146

Award Amount: $452,914.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: 4-Dimensional Optical Tissue Imaging by Variable Digital Illumination

This Small Business Innovation Research (SBIR) Phase II project has as its main objective the development of a mobile physiological optical imaging hardware and software system to empower clinicians with the ability to deploy, capture, assess and distribute standards compliant image data characterizing deep wounds and cardiovascular conditions. The mobile system will allow clinicians to rapidly identify the presence of hidden wound conditions or problematic blood flow patterns thus allowing care facilities to provide more cost effective and informed care to their patients, while minimizing financial losses associated with wound related hospital acquired conditions. The intellectual merit of this project lies in its scientific pursuit to define, develop, and distribute a comprehensive systems platform that will significantly accelerate the deployment of suitable physiological optical imaging solutions into the market. The research includes linking illumination patterns to physiological conditions while implementing mapping transfer functions by way of digital signal processing. The research objectives include system definition, integration, algorithmic optimization, and clinical validations.

The broader impact/commercial potential of this project is to provide substantially affordable noninvasive imaging tools that may be used to assist in treatments that are more accessible to persons in remote areas or those having economic disadvantages. The portable device increases the ability of qualified clinicians to access patient wound care imaging diagnostics remotely, improving quality of care and accessibility to society. Broader commercial benefits include reductions in hospital visits and stays due to more thorough wound assessments and greater accessibility. The mobile system will enable care decisions that are more closely coupled with the state of the underlying tissue and related hemodynamics. It will also allow clinicians and patients to more effectively monitor the benefits of care decisions. The development of the novel and cost-effective optical system to facilitate the imaging of clinically and physiologically meaningful information will fill a void in the medical imaging industry for a point of care solution capable of providing quantitative visualization of physiological processes critical to wound care. The development of the mobile imaging technology will enhance scientific and technological understanding in the areas of optical-tissue image mapping, optoelectronic illumination systems, image processing, clinical applicability and real-time imaging scenarios.

Sun Innovations Inc

Phase II Award No.: 0923749

Award Amount: $500,000.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: Novel Projection Display System

This Small Business Innovation Research (SBIR) Phase II project will develop a novel "fluorescent emissive projection" (FEP) display system, which will turn a glass window or windshield into a full color, high contrast electronic display panel, without blocking the view through the glass. The team will develop novel display engines as well as quantum dots based display materials while also integrating these key components into a full color 40 inch size FEP display prototype.

The reliability and regulatory concerns for commercial applications will be investigated in Phase II. If successful this innovative display-on-glass technology will create a broad spectrum of commercial applications with significant market sizes and economic benefits. Success of this project could enable a mass deployment of the display technology in commercial advertising places and automobiles. The new display technology will be applied broadly for many commercial applications, such as the display on store front glass windows or cabinets to attract consumers into stores. It will present real-time commercials on glass windows, without blocking the view into the store and its displayed merchandises. Given the huge number of glass windows and windshields where the technology can be implemented, it has very significant economic impacts.

Telescent Inc.

Phase II Award No.: 1057576

Award Amount: $407,660.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Optical Detectors Based on Transparent Microwires and Nanowires

This Small Business Innovation Research (SBIR) Phase II project will develop a new type of optical power monitor utilizing transparent microwires and nanowires patterned within a multi-layer anti-reflection coating. These "wires" are nanometer to micron wide traces defined within a transparent indium tin oxide (ITO) conductive layer. ITO typically absorbs 1 to 10% at visible and infrared wavelengths, depending on its thickness, and optical intensities greater than 1 mW/mm2 produce measureable localized heating. This temperature change induces a proportional resistance change that can be measured electronically. By inserting this detector in-line between fiber optic cables, the optical power of the internal signals can be measured without degrading the signal strength. Moreover, by reducing the dimensions of the trace to the nanometer scale, the detector also has the potential for high-speed operation with a bandwidth approaching GHz.

The broader impact/commercial potential of this project includes new optical monitoring applications that were previously impossible or impractical. In one example, inexpensive and miniature optical monitors can now be integrated within the hundreds of millions of fiber optic interconnects produced annually for fiber optic communication systems. Advanced self-monitoring and self-diagnosing communication network architectures can be developed for Fiber-to-the-Home networks and data centers by transparently measuring the optical power through fiber optic junctions. This technology promises to reduce the cost to measure power within optical fibers by two orders of magnitude, and has the potential to be mass-produced and even inkjet printed on flexible plastic film, window glass, solar panels, mirrors, displays, or even on curved substrates such as light bulbs and lenses.

TetraVue, Inc.

Phase II Award No.: 1058607

Award Amount:

Start Date:
End Date:

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Sector: Electronic Components and Devices

SBIR Phase II: Novel 3D Measurement and Imaging System

This Small Business Innovation Research (SBIR) Phase II project will build upon the success of Phase I which demonstrated the feasibility of a high resolution three-dimensional (3D) imaging system, based on a new technology that allows simultaneous 3D coordinate measurement and high resolution imagery using commercial off-the-shelf Charge-Coupled Device (CCD) or Complementary Metal Oxide Semiconductor (CMOS) sensors. Although stereoscopic 3D images and movies have existed for over 100 years, only recently have 3D laser scanners which can reach 1 mm accuracies for single points at ranges of tens of meters and triangulation systems which can achieve 0.1 mm accuracies at ranges up to 2 m been developed. These systems produce no images and must assemble a collection of single 3D points over time. Phase I demonstrated the ability to capture 3D images using a 6 megapixel focal plane array with sub-centimeter accuracy and identified areas where further improvement can be achieved. The Phase II effort will implement these improvements but will focus on the engineering, miniaturization and fabrication of a 3D camera prototype which has performance and a form-factor traceable to the alpha version of a commercial 3D survey-grade instrument.

The broader impact/commercial potential of this project will benefit multiple industries, from aerospace to industrial surveying to movie and game special effects, by providing the new capability to record and measure objects, motion and scenes in three dimensions with imagery and in real-time. Current technology, e.g. 3D laser scanners and motion capture systems, used to capture 3D coordinates of objects and surfaces is slow, difficult to use, and either can only be used on static objects or requires special suits and sound stages with limited resolution. Despite the difficulty and associated high cost, the value of 3D data is such that its use in 3D industrial survey has been growing at 40% per year, reaching $425M in 2008. The high resolution 3D camera technology subject of this SBIR has been demonstrated in Phase I to have the potential to increase the acquisition speed by 100X over current solutions while reducing total data collection and processing costs by 10X. While this speed and resolution improvement will have a large impact on current markets, the capability to have high resolution images of moving objects with 3D coordinate measurements at each pixel enables a large number of new markets such as 3D biometrics, security, cost-effective digital heritage preservation, real-time measurement of 3D trajectories and robotic vision.

Turner Designs

Phase II Award No.: 0923636

Award Amount: $500,000.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: An Accurate, Low Cost In-Situ Multi-Spectral Absorption Meter

This Small Business Innovation Research (SBIR) Phase II project will investigate the feasibility of an accurate low cost in-situ multi-spectral absorption meter for measurement of water properties. Current commercially available instruments are limited in their accuracy in real world conditions due to their design. They are also expensive due to the use of costly components such as lamps, filter wheels, spectrometers, etc. This project will explore the use of a novel patented construction method in combination with light sources, optics, and photodiodes to give scientists an accurate yet low cost research tool to measure absorption in-situ over a variety of wavelengths. Compared to currently available instruments, this instrument will be more sensitive, have a broader dynamic range, will be insensitive to interfering parameters (e.g. scattering) and will be able to measure in the ultraviolet region.

If successful the proposed product will help the scientific and general public communities better understand water quality in the natural world but also it could be of considerable benefit in broader kinds of chemical processing. Current commercially available in-situ absorbance instruments lack accuracy in field conditions and are relatively expensive. Hence they have not been widely adopted in the scientific community. A more accurate in-situ absorption meter dramatically improves the quality of the data that scientists can generate and reduces the amount of time they spend correcting for interfering parameters. The proposed instrument will address significant needs of organizations measuring water to understand natural processes as well as to determine water quality. A number of applications to measurements of other turbid liquids will be possible.

VALENCELL INC.

Phase II Award No.: 0848943
Phase IIB Award No.: 1047573

Award Amount: $1,015,927.00

Start Date: January 15, 2009
End Date: December 31, 2012

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Sector: Electronic Components and Devices

STTR Phase II: Monolithic Multiwavelength Blue-to-IR LED for Biomedical Diagnostics

This Small Business Technology Transfer (STTR) Phase II project, in collaboration with North Carolina State University, will develop and validate an innovative, mobile, multiwavelength pulse oximetry module for noninvasive health monitoring of various blood metabolites simultaneously in real time. At the heart of this pulse oximetry module will be a novel multiwavelength emitter having independent control of up to nine spectrally narrow wavelengths, ranging from blue to mid-IR, emitting from a single 1 mm2 LED die. In contrast with traditional dual-wavelength pulse oximetry, which measures oxygen saturation in the blood, the proposed multiwavelength LED will enable real-time analysis several additional metabolites critical to health monitoring via the same noninvasive paradigm. Furthermore, the individually controlled self-aligned wavelengths enable superior motion artifact cancellation, which is essential for eHealth and mobile fitness applications. The key objectives of this feasibility study are to: Demonstrate luminescent films with peak emissions from 400-1100 nm Integrate these films into a compact multiwavelength pulse oximetry module Optimize novel pulsing algorithms for multiwavelength pulse oximetry Validate the mobile multiwavelength pulse oximetry module in a lab setting

The medical impact of dual-wavelength pulse oximetry, in both saving lives and reducing healthcare costs, has encouraged the development of broader platforms using additional optical wavelengths. Incorporating 3 or more independently controlled wavelengths has been shown to enable the real-time monitoring of multiple health factors while further reducing readout errors - thus saving more lives. Beyond blood oxygen monitoring, a real-time noninvasive assessment of renal and hepatic health can be realized by integrating several wavelengths in the same clinically accepted pulse oximetry paradigm. Though multispectral pulse oximetry systems incorporating several optical sources have been successfully demonstrated by physicians and industry leaders, incorporating multiple LEDs (made from dissimilar semiconductors) has led to costly reliability errors and even product recalls. If successful the proposed mobile, multiwavelength single-die approach surmounts these limitations by providing independent control of several wavelengths from a single, self-aligned, compact LED. Integrating these advanced, cost-effective optical sources into traditional pulse oximetry opens up new markets in noninvasive metabolic monitoring for clinical research, paramedics, physical therapists, drug discovery, consumer eHealth markets, and home healthcare. As a spectroscopic source, other applications include air-quality/pollution monitoring and agricultural/industrial controls.

VENTURE GAIN, LLC

Phase II Award No.: 0924642

Award Amount: $499,426.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: Electronic Components and Devices

SBIR Phase II: Intelligent Personalized Monitoring of Ambulatory Human Biosignals

This Small Business Innovation Research (SBIR) Phase II project will build an end-to- end platform around the ambulatory monitoring device proposed in Phase I, for continuous health monitoring of a human. The Phase I wearable device measures multiple noninvasive biosignals from a person in their daily home routine (or in the hospital), providing unprecedented visibility into health or disease status outside a critical care setting. The Phase II platform will comprise an "ecosystem" of software for providing automated, scalable intelligent monitoring of the signals from the device using advanced machine-learning algorithms, and exception-based alerting of medical staff upon early indication of deteriorating health of an ambulatory patient.

If successful this platform will provide a substantial improvement in the capability of the healthcare system to proactively manage the health of the large population of patients with costly chronic diseases. Current methods for remote (home) patient monitoring "while better than a complete lack of monitoring" involve extremely sparse data (once per day) and require proactive patient compliance to make manual measurements, typically of weight or blood pressure. These methods do not handle ambulatory variation; in contrast, the proposed algorithms uniquely detect health anomalies otherwise hidden in ambulatory variation. This Phase II project not only has the potential to fundamentally improve healthcare with continuous automated visibility into patient health in the home environment, but also stands to provide unique insight into new signatures of disease heretofore not recognized by medical science. The advanced detection algorithms are able to learn empirically the normal physiological variation (e.g., variations in blood pressure, metabolic activity, etc., throughout the day) of the human system, and reveal incipient anomalies from normal behavior which are not visible upon a plain, univariate inspection of the data. Moreover, the device itself provides data from human activities not customarily encountered in the static conditions of a medical facility, where patients are supine and sedated. It is highly likely that this new approach to multivariate analysis of human biosignals will unveil new signatures providing early warning of disease progression, for example, decompensation in a heart failure patient.

Visualyze Technologies, Inc.

Phase II Award No.: 1058159

Award Amount: $492,118.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Wavefront Microscopy: A low-cost implementation of high-quality microscopic phase imaging for bioscience teaching and training

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize a revolutionary method to convert standard low-cost optical microscopes into high-performance, low-cost imaging instruments for biological research and education. The technology uses a specialized image sensor to render transparent biological samples visible at optical wavelengths without staining techniques or expensive optical microscope elements requiring extensive training. In addition, the technique naturally deconvolves amplitude and phase, enabling better interpretation of "dark spots". This project represents a major application of silicon photonics, exploiting the vast semiconductor fabrication infrastructure for novel optics manufacturing techniques. In addition, this proposal addresses selected performance improvements, such as noise reduction via an added cooling unit and enlarging the field of view through denser pixel arrays. When fitted to a standard laboratory microscope, our novel sensor camera offers the capability to produce high-quality, real-time in vivo microscopic phase imaging at a significantly lower cost.

The broader impact/commercial potential of this project is to enable high-quality, real-time microscopic images of in vivo biological samples. Our business strategy and product plan addresses two potential marketplaces: 1) Secondary schools, college teaching laboratories, and other educational settings; and 2) Academic and industrial research laboratories. Our market penetration strategy provides for educational microscope users to access our novel imaging capabilities at significantly reduced cost, revolutionizing bioscience teaching and training by rendering transparent samples visible in real time and enabling new curricula with a higher experimental component. Academic and industrial researchers also can exploit our innovative technology, using it for better imaging capabilities and removing ambiguities in dark spot interpretation. Our camera is entirely compatible with standard microscopes, enabling retrofits without technical challenges or the need for advanced training; it is also useful for observation of cultures in standard culture dishes, unlike competing techniques. This technology lies at the cutting edge of silicon photonics applications for biotechnology and represents an exciting new way to leverage silicon manufacturing economics for imaging applications.

Vortex Hydro Energy LLC

Phase II Award No.: 1026367

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

STTR Phase II: Havesting Hydrokinetic Energy Using Vortex Induced Vibration and Fish Biomimetics

This Small Business Technology Transfer (STTR) Phase II project will advance the development and prototype testing necessary to transition an innovative large scale generating system from concept to commercialization. The underwater energy generation system is based on the naturally occurring phenomenon of vortex induced vibration (VIV). This device harvests hydrokinetic energy via a system of cylinders that oscillate due to water currents at velocities as low as 2-3 knots (water turbines require 5-7 knots). This system captures energy from water currents - unlike hydroelectric power there are no dams or turbines. The proposed research and development includes: (a) Application of Passive Turbulence Control (PTC) to enhance the hydrodynamic effect of VIV and increase hydrokinetic harvested energy for large scale cylinders; (b) Identification of optimal cylinder spacing as a result of using PTC; (c) Installation of a large 4-cylinder module in the St. Clair River in Port Huron, MI; (d) Classification and research of appropriate materials to extend period between maintenance cycles in harsh marine environments.

The broader impact/commercial potential of this project is that it taps into a vast new source of clean and renewable energy - water currents as slow as 2 to 3 knots. Currently, there are only pilot devices for harnessing horizontal hydrokinetic energy (currents, tides). All devices considered are conventional propeller/turbines that target speeds around 5-7 knots (only seven locations with these conditions exist in the US). The vast majority of river/ocean currents in the United States are slower than 3 knots. This leaves the vast majority of rivers and bodies of water in the country untapped for power generation. Renewable energy generation is one of today's most challenging global dilemmas. The energy crisis requires tapping into every source of energy and developing every technology that can generate energy at a competitive cost within the next 50 years. Development of this technology will bolster domestic energy security and mitigate global climate change. There are numerous commercial and military applications from small scale (1-5kW) to large scale (100MW). Applications span from small portable devices, to direct water pumping for irrigation, direct pumping for desalination, off-shore stations, idle ships, coastal naval bases, etc.

XIGEN LLC

Phase II Award No.: 0923653

Award Amount: $435,129.00

Start Date: September 15, 2009
End Date: August 31, 2011

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Program Director: Juan E. Figueroa

Sector: Electronic Components and Devices

SBIR Phase II: A Novel 360-Degree Video Surveillance Camera

This Small Business Innovation Research (SBIR) Phase II project will develop a novel 360° video surveillance camera which provides a simultaneous panoramic 360° field of view (FOV) using optical unwrapping, instead of digital unwrapping. The company's proprietary imaging technology can provide 70% greater image resolution than conventional cameras using the same sensor chip, and employs no moving parts. Not only can it acquire 360° video of a surrounding scene, but also such 360° video images can be viewed directly, for the first time, without need of external computational hardware/software for unwrapping. The proposed camera would perform video surveillance with unprecedented panoramic 360° field of view that eliminates blind spots, and greatly enhances image quality. The directly viewable 360° video would also enhance visualization, communication, and response time in surveillance practice.

The proposed imaging technology developed under this SBIR program is a platform technology with numerous potential applications. As a breakthrough optical imaging technology, it will lead many researchers and practitioners to rethink the way video images are captured and spawn commercial ventures to bring it to various commercial markets. In addition to enabling video surveillance products, e.g., 360° box camera, pen-tilt-zoom (PTZ) camera, miniature camera, etc., this technology will lead to commercial applications in areas such as medical and industrial endoscopes, pipe inspection, turbine engine diagnosis, automotive safety devices, navigation, mobile robotics, video conferencing, and internet webcast. The company has selected three vertical markets in which to develop innovative product(s) offering significant value propositions. These three vertical markets are: (1) video surveillance cameras (~$13 billion), (2) automotive safety products, e.g., rearview mirrors and parking sensors, (~$13.4 billion), and (3) medical and industrial endoscopes (~$4.3 billion).

AccuStrata Incorporated

Phase II Award No.: 1026370

Award Amount: $432,016.00

Start Date: October 1, 2010
End Date: September 30, 2012

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Program Director: Muralidharan S. Nair

Sector: Electronic Systems and Instruments

SBIR Phase II: Real Time Optical Control System for Thin Film Solar Cell Manufacturing

This SBIR Phase II project is directed at developing a real time process control system for improving manufacturing of thin film products such as thin film solar panels, solid state lighting, touch screen displays, optics and telecommunications. Photovoltaics are a vital component of the renewable energy mix but they need to be more efficient to be competitive against existing fossil fuel approaches. The system will be able to dynamically control and correct the film deposition process in order to keep each product within its targeted specification, reducing and even eliminating rejects. It allows manufacturing of more consistent and uniform solar panels resulting in higher solar conversion efficiency, reduced cost and increased manufacturing yield. The objective of this Phase II is to further develop and improve the prototype system developed under Phase I and IB and validate it for two most common thin film solar panel manufacturing configurations. This project will complete the hardware / software development and validation for monitoring film growth for amorphous silicon solar panel manufacturing. Phase II will remove technical risk allowing fast commercialization of the monitoring system. Additional development will be performed to finalize the control component of the system.

The commercial potential of this project is to advance the scientific understanding of how thin films grow during deposition. It will help thin film solar panel manufacturers to develop higher quality products. The system will improve production accuracy, reduce production flaws and make the manufacturing process less susceptible to process parameter drifts and errors,especially for advanced thin-film products. The commercial impact of the project is that manufacturers will increase solar panel efficiency and manufacturing yield, reduce manufacturing cost, and increase revenue and profit. The proposed technology provides an innovative platform solution that can be further improved in order to achieve waste-free thin film manufacturing with little human interaction. This system, if adopted by only 30% of the thin film manufacturers will result in roughly $1 billion in savings by 2015. The societal impact of the project is to help make solar panels a competitive source of energy against existing fossil fuel approaches. The system will allow manufacturers to meet the market demand for lower cost solar products which will accelerate PV adoption worldwide thus helping to reduce global warming and reduce our dependence on oil.

Active Spectrum Inc.

Phase II Award No.: 1058145

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Muralidharan S. Nair

Sector: Electronic Systems and Instruments

SBIR Phase II: Airborne Soot Sensor for Improving Fuel Efficiency and Reducing Pollutants

This Small Business Innovation Research Phase II project will result in the development of a miniature airborne soot sensor for automotive diesel engine exhaust sensing applications. Current government regulations mandate that by 2012, all diesel vehicles sold in the United States will be equipped with onboard NOx and airborne particulate matter sensors. The proposed particulate matter sensor is based on the principle of electron spin resonance (ESR) spectroscopy. This sensor technology will be miniaturized and hardened for use in an automotive application for airborne soot sensing. Design changes intended to meet aggressive cost-reduction goals are an important feature of the project. The end result will be an automotive-grade, low-cost airborne soot sensor that can ensure end-users' compliance with new diesel engine emissions standards.

The broader impact/commercial potential of this project is a reduction in airborne particulate matter emissions. Airborne particulate matter has been identified by the US government as one of six criteria pollutants with potentially serious health and environmental effects. Among the largest sources of airborne particulate matter (PM) are diesel vehicles and power plants. We propose a new, low-cost and highly specific airborne soot sensor based on a miniature electron spin resonance sensor technology. The upcoming government regulations for onboard vehicle diagnostics, combined with similar regulations abroad create a market for approximately 6.3 million airborne soot sensors per year worldwide. It is expected that the worldwide market size for onboard airborne soot sensors will grow to approximately $350M/year as a result of upcoming regulatory changes.

Aquatic Sensor Network Technology LLC

Phase II Award No.: 1026790

Award Amount: $499,720.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Developing a Real-time High-data-rate Multicarrier Underwater Acoustic Modem

This Small Business Innovation Research (SBIR) Phase II project aims to develop a real-time high-data-rate multicarrier underwater acoustic modem for aquatic applications. The modem to be developed will achieve a data rate that is more than one order of magnitude higher than all competing commercial products in challenging shallow water environments. It will have robust error performance in the presence of impulse-like noise and undesired disruptions. In addition, the modem will be power efficient to sustain long operation time, have a user-friendly interface, and maintain an easily-extendable architecture to facilitate advanced networking functionalities. Bringing the advanced multicarrier technology into the underwater modem market, this project solves one long-standing problem in the field, i.e., making multicarrier modulation work in underwater channels (earlier attempts all had only limited success). With one order of magnitude data rate increase, this project will significantly advance the state-of-the-art in underwater telemetry.

The broader impact/commercial potential of this project is that the high-data-rate multicarrier underwater acoustic modem will significantly improve the operation of a wide range of aquatic applications, such as underwater environmental observation for scientific exploration, commercial exploitation, and coastline-protection/target-detection in military or anti-terrorism. It will also directly facilitate the development of emerging and fast-developing underwater wireless sensor networks and autonomous underwater vehicle networks. The significantly enhanced monitoring capability of aquatic environments will help us better understand and exploit the earth, preserve and protect it for our future generations. As more than 85% of underwater applications are envisioned to be in shallow water, this project will have enormous commercial impact in multiple market sectors including environment, energy, fishing, tourism, and national defense, etc.

Barrett Technology Inc.

Phase II Award No.: 0823008
Phase IIB Award No.: 1105104

Award Amount: $1,024,000.00

Start Date: November 1, 2008
End Date: April 30, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Low-Cost Ultra-Efficient 50-gm, 300-W Servoelectronics Module with Integral Sensors

This Small Business Innovation Research (SBIR) Phase-II research project aims to cut the manufacturing cost of an innovative power-efficient ultra-miniature, brushless-servo-electronics module from $1,000 to $100. The module integrates all rotor-position sensing, vector-based commutation, controls, and power supplies needed to drive high-performance brushless servomotors rated up to 300 W (Root Mean Square) and 2 KW (peak) into a single 50-gram module not much bigger than a bottle cap. The cost reduction relies on a set of innovations led by replacement of laser optics used for rotor-position sensing with an array of magnetic field sensors measuring a calibrated target magnet. Phase I demonstrated that well-placed shielding enables high precision and excellent commutation performance even in the proximity of stray fields produced by high switched currents and spinning rotor magnets located in the motor body only millimeters from the sensor array.

This servo-electronics module fits the definition of disruptive technology for entrenched players, such as Danaher/Kollmorgen, Siemens, Fanuc, and Yaskawa, while it will enable scores of original equipment manufacturers (OEMs) to improve the performance, compactness, power efficiency, and reliability of their machines at competitive prices. As machines become more intelligent through embedded processing and sensor fusion it will improve not only industrial productivity, but quality of life as society ages. While embedded processors and MEMS-based sensors have become tiny, highly effective, and affordable, similar improvements in servomotors have evolved more slowly. At fractional-horsepower levels the power electronics contribute significantly to total motor-system bulk and complexity. Providing smaller and more efficient servo-electronics will enable OEMs to increase the competitiveness of their products. Robots will become more agile with additional degrees of freedom and less mass to accelerate.

Barrett Technology Inc.

Phase II Award No.: 1058474

Award Amount: $481,971.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Force-Controlled Robotic Arm Capable of Sub-Millimeter Precision

This Small Business Innovation Research (SBIR) Phase II project proposes a portable, interactive Coordinate Measuring Machine (CMM) for geometric data collection consistent with statistical sampling of a series of parts. The innovation exploits a characteristic of cable drives that supports precise repeatability in an articulated arm. To optimize production and avoid scrap generation, manufacturing process corrections must occur promptly and yet must be based on adequate measurement data. Existing metrology systems inhibit these preferred statistical process control principles. Large motorized CMMs are either taught offline using computer-aided design (CAD) models or online using awkward joystick interfaces. Manual-only portable-arm CMMs are safe and convenient to use, but teach-and-playback is not supported. The proposed solution is a motorized articulated robot that combines the safety of a manual system with playback precision thereby supporting convenient statistical process control (SPC). The research objectives are to design and build a motorized CMM and develop the algorithms, tools, and procedures needed to create a successful product. The anticipated commercialized product will be a portable, user-friendly, cost-effective robotic arm that spreads the quality advantages of statistical process control across a broad range of products and manufacturers including non-traditional manufacturing such as medical surgery.

The broader impact/commercial potential of this project has four parts. The first is the direct impact on the US economy. US workers will assemble, test, and ship the products developed under this SBIR. Components will be sourced from local US fabricators and OEM suppliers, boosting the US economy and generating taxes; and some of these products will become exports, reducing the US imbalance of trade. Secondly, the shortcomings of metrology devices available today discourage the use of statistical process control, thereby undermining manufacturing quality. The proposed solution will improve manufacturing competitiveness in the metrology market sector through easier adoption of statistical process control, leading to higher quality and reduced scrap costs. Thirdly, the proposed solution invites production-line workers back into close physical contact with the process that they must ultimately understand and control. The worker strengthens intuition by teaching the device for each new part geometry, while the playback capability avoids tedium and repetitive stress. Corporations often automate these workers out of their skilled jobs who then join the unemployed while the company loses touch with the ability to understand and innovate processes. Finally, this SBIR will support formal internship programs with several universities in order to maintain diversity.

Berkeley Exotech, Inc.

Phase II Award No.: 0924037

Award Amount: $508,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Electronic Systems and Instruments

STTR Phase II: In-Home Rehabilitation System for Post Stroke Patients

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project proposes to create an in-home gait training device that allows a post-stroke patient to undergo rehabilitation with little or no assistance. Approximately 500,000 Americans survive a stroke each year. Miraculously, most stroke survivors can relearn skills, such as walking, that are lost when part of the brain is damaged. They can relearn walking most effectively if they are aided in making the correct motions by a machine or a physical therapist while attempting to walk. This training is expensive and requires the patient to make regular visits to a stroke center or qualified physical therapy center. Berkeley Bionics proposes to create a lightweight robotic exoskeleton which cradles a patient's lower extremities and torso, and maneuvers their rehabilitating limbs for them.

The broader impacts of this research are immense. These devices could move most post-stroke rehabilitation out of the clinical setting thereby reducing labor costs dramatically. The gait training exoskeletons will be wearable, very unobtrusive, and allow patients to maneuver in the real world. Patients would therefore be able to wear such devices for most of the day, thus remaining mobile and gaining the therapeutic effects of physical therapy over the course of a day, rather than just a short session. Furthermore, creating such a device will also give clinicians an alternative to the wheelchair to assist patients who are unable to recover adequate mobility to function in their daily lives. This could potentially reduce unhealthy effects of wheelchair use for millions.

Berkeley Exotech, Inc.

Phase II Award No.: 0956801

Award Amount: $500,000.00

Start Date: February 1, 2010
End Date: January 31, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Lower Extremity Exoskeleton Assist Device for Reducing the Risk of Back Injuries among Workers

This Small Business Technology Transfer (STTR) Phase II project proposes will study the technology barriers associated with creating exoskeleton assist devices for workers in distribution centers and automobile assembly plants. By using these devices, workers can dramatically reduce the load in the vertebrae of the lower back when maneuvering parts and boxes. The assist device will take the majority of the load off of the user's body. Such collaboration between humans and machines has the benefit of the intellectual advantage of humans coupled with the strength advantage of machines. The proposed project involves the University of California at Berkeley as research partner, General Motors Corporation, and the U.S. Postal Service. The end goal is a reduction in back injuries in the workplace which are considered by OSHA the nation's number one workplace safety problem.

The broader impacts of this research are reduced worker's compensation insurance costs, reduced disability payments, increased worker productivity, and the ability for workers to keep working into their older years. Furthermore, these new devices will open an entirely new market which will serve an important role in establishing the United States as the number one player in the emerging field of bionics. Additionally, establishing this market for exoskeletons will enable the development of other exoskeleton markets which include military exoskeletons for carrying backpack and body armor loads, rescue worker exoskeletons, stair climbing exoskeletons for urban firefighters, and wild-land firefighter exoskeletons. The potential impacts to worker safety and American quality of life are large and diverse.

Blended Integrated Circuit Systems, LLC

Phase II Award No.: 0924010

Award Amount: $599,414.00

Start Date: September 1, 2009
End Date: February 29, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Blended Clocked and Clockless Integrated Circuit Systems

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project will develop and apply a principled design methodology to confront the serious problems associated with deep sub-micron, system-on-chip, integrated-circuit designs. The project will develop design services for companies wishing to market complex, proprietary, low-power integrated circuits through the development of a unique design tool, one which will apply a mathematically sound approach to the production of large, hazard-free, network-on-chip products. The goal for this tool is to reduce traditional design cycles by eliminating most of the global verification effort while improving the robustness of the design. New results in predicting the behavior of deep submicron arbiter circuits are essential to this work and will also be reported.

The broader impacts of this research are to reduce design costs, time-to-market and power consumption. More broadly this can: 1) significantly increase the productivity of integrated-circuit design engineers, 2) reduce power consumption of electronic control, communication and computational systems and 3) increase our competitiveness against off-shore system-on-chip designers particularly with respect to low volume products. Thus, successful completion of this project is important to the future of the national electronics marketplace because, without a major reduction in the time spent on global verification, the benefits of higher levels of integration, including reductions in time-to-market, conservation of power and increases in reliability, will not be available to many important electronics market sectors.

Bluewater Technology

SBIR Phase II: Commutational Ramp Load Disk Drive Actuator

Phase II Award No.: 1058569

Award Amount: $444,880.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

This Small Business Innovation Research (SBIR) Phase II project will design, build, test, and validate a fully operational prototype disk drive incorporating a commutational ramp load actuator (CRLA). The CRLA is a unique and transformative actuator for disk drives that provides significant improvements over existing actuator technology by increasing performance and reducing cost. The research objectives consist of a systematic distributed parameter design for the CRLA components, quantification of intrinsic parameters and performance characteristics, design and synthesis of a robust trajectory and control algorithm to fulfill the ramp load/unload requirements, and verification of repeatability and reliability of the ramp load/unload process. The CRLA design requires travel through a magnetic transition zone which presents an input singularity at a location on the ramp within the actuator sweep angle resulting from a zero torque factor. To promote travel on the ramp and through the region near the input singularity point on the ramp, a robust closed-loop control algorithm will be developed that will provide failsafe ramp load/unload operation through the transition zone. It is anticipated that the research will lead to a technically sound and robust CRLA prototype actuator which will provide significant performance improvements and cost savings.

The broader impact/commercial potential of this project is immediate and long-term. The immediate commercial potential is the specific application of the technology to the current 550 million units per year disk drive market for computers, servers, data backup systems, communication technologies, and many consumer products such as digital video recorders. The CRLA technology is expected to provide cost savings of $0.17 to $0.47 on magnet, coil, and latch materials for each disk drive. Additional cost savings are realized through a reduction in product liability, warranty, and return costs. This technology will provide a direct benefit to society via manufacture of a consumer product that is of a lower cost and higher performance. This innovation will enhance scientific and technological understanding of devices that require control through singular regions, with potential application in diesel engines and various military defense and security technologies. Additional broader impacts include: (a) realistic engineering training for students; (b) improving local economy by creating manufacturing jobs; (c) involvement of undergraduate students and preparation of project modules to enhance undergraduate curriculum; (d) collaboration with practicing engineers; and (e) immediate transfer of technology to disk drive industry.

Carley Technologies, Inc.

Phase II Award No.: 0956792

Award Amount: $459,455.00

Start Date: April 15, 2010
End Date: March 31, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Tunable RF Front Ends for Wireless Devices

This Small Business Technology Transfer (STTR) Phase II project addresses the creation of tunable radio frequency filters for future wireless devices. The proposed approach combines research on advanced magnetic materials with research on nano-structuring of magnetic and non-magnetic materials with the goal of achieving an order of magnitude or more increase in quality factor (Q) and maximum value of inductors (Ls) used to implement tunable inductor capacitor (C) filters at frequencies up to 5GHz; specifically Ls > 50nH, Qs > 100, and self-resonance frequencies > 3 GHz. The approach is to economically deposit oriented high-moment magnetic materials in a non-magnetic matrix to achieve high permeability while avoiding eddy current losses at high frequencies through the use of nano-structuring. In addition, this research will explore novel circuit design techniques for radio front ends that will exploit inductors fabricated using the proposed structures to implement tunable radio frequency filters suitable for advanced wireless devices. Novel circuit design approaches must be developed because the LC filters built using the proposed technology will have significantly lower Q than existing surface acoustic wave filter technology; but will offer new advantages of tunability, circuit topology flexibility, and amenability to fabrication over integrated circuits.

The broader impact/commercial potential of this project is that it would contribute to making 'cognitive radios' practical. Cognitive radios are ones that can opportunistically seek out portions of the frequency spectrum that are currently unused in their local vicinity and then use them for communications, dramatically reducing congestion in the airwaves of major cities by allowing aggressive reuse of frequency spectrum. Cognitive radios have the potential to increase the aggregate data rate available in dense urban environments by more than an order of magnitude. Today, such radios are economically unattractive because the RF front end filters would have to be implemented using one fixed surface acoustic wave filter for every possible band. However, the tunability of the proposed enhanced LC filters greatly facilitates the creation of low cost cognitive radios. In terms of commercial impact, the proposed tunable LC filters would revolutionize how RF front end modules for cellular radios (a >$7B/year market) are designed. Translating this into societal impact, the proposed technology has the potential to increase the data rate with which the population at large can access data stored on the network using wireless devices in the mobile internet by more than an order of magnitude.

Cyclos Semiconductor

SBIR Phase II: Ultra-Low Power Microcontroller Design

Phase II Award No.: 0724361
Phase IIB Award No.: 0957888

Award Amount: $952,000.00

Start Date: August 1, 2007
End Date: July 31, 2011

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Program Director: Muralidharan S. Nair

Sector: Electronic Systems and Instruments

This Small Business Innovation Research Phase II research project will investigate novel integrated circuit design technologies for the realization of ultra-low-power microcontrollers. The main objective of this project is to investigate the deployment of novel charge-recovery circuitry for the design of an ultra-low-power leading-edge commercial microcontroller core. The resulting charge-recovery core is expected to dissipate 25-30% less power than its conventional counterpart. In conventional circuit design, capacitors are switched abruptly between supply and ground, dissipating all their stored energy as heat across resistive devices. In charge recovery design, on the other hand, capacitors are switched gradually, returning any energy that remains un-dissipated back to the power supply. The significant potential of charge recovery to reduce power consumption has so far remained untapped in the commercial world, primarily due to the lack of support for such a new design style that deviates from established design practices.

The results of the proposed research are commercially applicable to the realization of a broad class of computer systems and consumer electronic devices that are subject to power efficiency requirements. Microcontrollers are essential elements of every System-on-Chip (SoC) and typically account for a substantial fraction of overall chip power, since they remain on most of the time. Embedded microcontrollers are key components of semiconductor chips for mobile devices such as cell phones and personal digital assistants. Generating a commercial microcontroller core with substantially reduced power consumption will lead to a broad variety of next-generation computer and communication systems with enhanced features, longer battery life, and improved performance.

Esensors Inc.

Phase II Award No.: 0923942

Award Amount: $680,643.00

Start Date: September 1, 2009
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: High Resolution Tunable Receiver For Remote THz Sensing

This Small Business Innovation Research (SBIR) Phase II research project is aimed at developing devices for the detection of terahertz (THz) signals and a spectrometer based on these devices. To date, the lack of suitable electronic devices have made the THz region of the electromagnetic spectrum inaccessible except by use of large and costly scientific instruments. The aim is to develop a simple, low-cost, low-power receiver which will make this important region accessible. The three critical components of the THz heterodyne receiver are an antenna, microbolometer/mixer and quantum cascade laser which functions as a local oscillator. With these novel components it is possible to develop a portable, field-deployable THz spectrometer capable of monitoring a wide variety of gases in its vicinity. The high-sensitivity spectrometer will allow rapid identification of chemicals and remote sensing of gases for environmental, global warming, and homeland security applications.

The broader impacts of this research are that the THz receiver, which has high sensitivity and high spectral resolution not achievable with existing devices, can be used in a much wider variety of imaging and screening devices. THz screening of personnel is non-invasive and harmless. Explosives and biological agents can be detected and identified even if concealed in clothing and suitcases because the THz radiation is transmitted through clothing and luggage. The proposed receiver also has a potential of providing THz imaging of biological materials and broad-band transmitting of digital signals.

Evigia Systems Inc.

Phase II Award No.: 0956908

Award Amount: $463,803.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Batteryless Wireless Smart Labels with Embedded Non Volatile Memory

This Small Business Innovation Research (SBIR) Phase II project continues the development of a new class of wireless miniature smart sensor labels that continuously track and record exposure to the environmental conditions, and directly store the sensed data in digital CMOS non volatile memory (NVM) without requiring any battery. These CMOS-sensor chips are able to track temperature (-50°C to 70°C), humidity (5% to 100% RH), and shock/impact (50g to 250g), in a total volume of less than 1.5mm x 1.5mm x 0.7mm. The CMOS-sensor chip can be embedded in a standard passive radio frequency identification (RFID) inlay to form a fully integrated multi-sensor environmental condition tracking wireless device that is able to be deployed in a scalable RFID network. A multi-faceted innovative approach in MEMS devices and digital non-volatile memories enables the proposed CMOS-sensor chip. The temperature and humidity sensors fabricated and micropackage processes developed in Phase-I successfully demonstrate the technical feasibility and commercial viability of the proposed wireless smart sensor labels. The outcome of the proposed effort meets the form factor, functionality, and price-point requirements of embedded and widely-dispersed sensing, in a broad range of applications.

The broader impact/commercial potential of this project is on several existing industries, larger and more significant impacts on new markets and industries to be formed around this innovative and powerful technical ability. We believe that the existing live/bio material delivery segment can generate up to $500 million yearly sales for Evigia based on our technology directly reducing up to $1.4 billion of vaccine potency destruction each year, and saving up to $150 million yearly of blood plasma being destroyed during transportation. Commercial delivery logistics of sensitive/high-value goods and fresh produce is another large existing market where we can bring direct benefit up to $5 billion yearly in the US based on our smaller, lower cost, batteryless solution being included to monitor shipping quality in a far larger fraction of all packages being shipped in the US. The underlying technology of the proposed effort could be also potentiality employed in development of a broader family of advanced systems including improved diagnosis and treatment of mild traumatic brain injury (TBI) which affects millions of Americans annually through sports and other accidental injuries.

Fidelity Comtech Inc.

Phase II Award No.: 1058597

Award Amount: $488,450.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Dynamic Broadband Wireless Networks

This Small Business Innovation Research (SBIR) Phase II project will demonstrate the ability of an adaptive antenna system - a radio with an antenna that changes its radiation pattern to provide coverage where it is needed - to automatically optimize coverage. Harsh RF environments, for example those with shifting reflective surfaces such as shipping container yards, make it hard to set up reliable communication even when there is only one radio. When several radios must work together to provide coverage in an extended area, it is extremely difficult and time-consuming to manually tailor the radiation pattern of each antenna so that every portion of the area receives adequate signal and the radios do not interfere with each other. Through a combination of innovative pattern computation algorithms and active sensor feedback, the system resulting from this project will automatically tailor coverage to meet these goals. The system will not just be able to set up the initial coverage of an area, it will also continually monitor the quality of the coverage and automatically adjust to changes in the system or the environment that may affect the quality of that coverage.

The broader impact/commercial potential of this project is decreased deployment costs and substantially increased reliability. In the short run, the system will be built with a WiFi platform for use in the maritime ports market as a more reliable communication system to run their mission critical scheduling application. The deployment savings result from not only a quicker and more reliable initial setup but also from automated adjustments to coverage as environmental factors change, including such radical changes as the failure of one radio. Because the system is agnostic to the frequency and the protocol used by the radio, it is not limited to WiFi deployments. The project will demonstrate this by creating and operating a prototype WiMAX version of the adaptive antenna system. In the long term, this adaptive antenna technology offers significant benefits to any large scale radio deployment. For example, as providers roll out the next generation of cellular, cell sizes will shrink significantly which will substantially increase the deployment cost. An adaptive antenna system offers not only the promise of reducing these costs but also adding increased connection reliability to these next generation systems.

HMICRO, INC.

Phase II Award No.: 0848913
Phase IIB Award No.: 1132037

Award Amount: $600,000.00

Start Date: March 15, 2009
End Date: August 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: Wireless Healthcare Disposables

This Small Business Innovation Research (SBIR) Phase II research project will further validate a groundbreaking wireless semiconductor platform that enables disposable, body-worn, physiological monitoring wireless sensors (wireless disposables) for a wide range of applications in healthcare and other industries. The company's chips are combined with today's body sensors such as electrocardiogram (ECG), Saturation of Peripheral Oxygen (SpO2), and blood pressure, to produce wireless disposables for continuous monitoring. For mass deployment, wireless disposables must displace today's wired sensors, therefore must have equally low cost, similar reliability, and days of operating life for a single use. Conventional radios are too unreliable, too power hungry and cause high interference to meet this challenge. The company is creating a single chip solution by combining radio with sensor functions providing a gain of 50X over conventional radio based solutions in terms of low power, low cost and wire-like reliability.

Eliminating the wires connecting a person's body to a patient monitor long held as impossible to replace could be possible with the proposed solution. Healthcare markets, the initial focus of the company (dominated by hospital use), represent more than a $2B market in disposables. The wireless disposables will have a broad global impact by contributing to cost effective, high quality care in hospitals and other care settings. In hospitals, wireless disposables can eliminate reusable monitoring wires, products which have been demonstrated to carry drug resistant pathogens in up to 75% of cases. Wireless disposables are also aligned with a future vision of highly automated institutions that support a more natural workflow. Outside the hospital, wireless disposables allow remote and mobile monitoring of people with chronic diseases, enabling early interventions, an important goal in maintaining health and lowering costs. Wireless disposables will help solve the global healthcare crisis, with US costs over $1.5 trillion and rising rapidly as 78 million baby boomers near retirement.

Innovative Micro Technology

Phase II Award No.: 0924405

Award Amount: $483,327.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: SWARS IR Camera

This Small Business Innovation Research (SBIR) Phase II project will develop a microfabricated subwavelength antireflective structure (SWARS) for use with a MEMS infrared detector to form and infrared camera. The SWARS structure was prototyped in Phase I and shown to allow greater than 90% of incident radiation in the 8-12 ìm portion of the IR spectrum to pass, thus performing better than standard antireflective (AR) multilayer coatings which presently perform this function. These AR coatings are notoriously unreliable, as the thick films tend to delaminate during the processing and packaging of the IR device. In this Phase II project, the SWARS devices will be mated with a thermal light valve (TLV) to make the IR camera.

If successful the proposed approach may be used to produce MEMS devices for a broad range of IR applications, including gas sensors, IR beacons and IR thermographers. Because of their superior transmission properties and the robustness of the design to temperature fluctuations SWARS structures will be used in devices which must operate over a wide range of temperatures, and withstand virtually any operating or processing temperature. Such applications include equipment for factory floor inspections, power grid monitoring, maritime navigation, and security monitoring, in addition to fire fighting and first response.

Insitutec, Inc.

Phase II Award No.: 0924000

Award Amount: $616,000.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: 3-D Surface Profilometry using Standing Wave Technology

This Small Business Innovation Research (SBIR) Phase II research project will address the continued development of a novel sensor to enable form and finish of complex microscale structures as well as extend the technology to larger parts requiring three dimensional surface profilometry. The company is partnering with a global leader in the metrology industry to adapt this sensor and the corresponding gauging technology to their coordinate measuring machine. The culmination of this work will be a capstone industry specific demonstration on a new three dimensional surface profiler.

The broader impact of this research is the ability to provide a measurement capability not currently possible in one tool. Form and surface finish are inseparable in manufacturing and significantly impact functionality of a component in industries ranging from medical implant (for orthopedic bearing surfaces) to automotive (crank shafts or injector spray holes). Product reliability in these applications depends on the quality of the subcomponents and mating parts which is defined by the capability of the measurement technology. This measurement tool will provide a new measurement capability that will ultimately give better understanding of the manufacturing process and therefore the ability to make a higher quality and safer product.

KWJ Engineering Incorporated

Phase II Award No.: 1058563

Award Amount: $489,014.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Screen-Printed Gas Sensor using Nanoparticulate Catalyst

This Small Business Innovation Research (SBIR) Phase II project seeks to combine the technology for a high performance amperometric gas sensor, AGS, with the fabrication methods of printed electronics, first for sensing carbon monoxide (CO). In Phase I KWJ demonstrated a unique combination of technologies and fabricated a CO sensor that, in performance testing, was compared to commercial sensors 10-100 times larger and 10-100 times more expensive. The new unique geometry sensor response characteristics we as good or better than commercial sensors. The printed-AGS sensor provides a general platform for sensors that is both low cost and high performance. In Phase II, this novel Printed-CO-sensor and the process for fabrication will be optimized and innovative beta-prototypes designed and fabricated. The prototype sensors will be subjected to comprehensive testing and integrated with state-of-the-art electronics including tiny micro-powered RFID technology to demonstrate a fully compensated, high performance, yet low-cost, CO sensor and sensor system. This would represent the first major advancement of AGS technology in the USA in several decades, and the resulting product is potentially disruptive to the marketplace.

The broader impact/commercial potential of this project lies in the ability of this novel, inexpensive printed gas sensor to combine the high performance found in the AGS technology and the modern fabrication technology from the microelectronics industry. The innovative products from this NSF SBIR can open a new landscape for sensor use. Legislative trends are pointing to a need for a low cost, high performance CO sensor. The result of this work will be the next leap forward in the existing widely used AGSs for monitoring. Initial impacts will include: 1] improvements in CO sensors allowing high performance home CO alarms to better protect human health as well as property, 2] widespread monitoring capability in transportation and infrastructure applications, important to both safety and homeland security; and 3] the ability to integrate gas monitoring into consumer products and create instant worldwide networks to monitor and assess for improved health and safety as well as environmental protection. The printed AGS may not only replace millions of larger sensors now sold, reducing cost and material use by 10-100X, providing a greener footprint for sensors, but also enable evolution of high performance sensing capability into new and larger markets.

Lake Shore Cryotronics, Inc

Phase II Award No.: 0956816

Award Amount: $499,429.00

Start Date: March 1, 2010
End Date: February 29, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Active Fiber Optic Sensor Array for Cryogenic Fuel Monitoring and Management

This Small Business Technology Transfer (STTR) Phase II project will develop a multi-functional active fiber Bragg grating sensor technology for the monitoring and management of cryogenic fuel such as liquid hydrogen and liquefied natural gas. The proposed technology uses in-fiber light to actively adjust sensor temperature, which will drastically improve responsivity and sensitivity of fiber sensors in the cryogenic environment. By coating fiber Bragg grating sensors with functional films, liquid fuel levels, spatial distribution, hydrogen concentration, and temperature can be simultaneously measured at cryogenic temperatures. Active sensors to be developed in this program are immune to electromagnetic interference and can be multiplexed in a single fiber, which allows a one-fiber and one-fiber-feedthrough solution for the cryogenic fuel management on the ground and in space.

The broader impact/commercial potential of this project will be the development of a prudent sensing technology and system to improve the safety and reliability of the use of both liquid hydrogen and liquefied natural gas fuels. As major alternative fuels to power the U.S. economy for decades to come, they share a high economic value that requires accurate and reliable metering and management. Having a flexible, multi-use system available that can be installed with absolute confidence to monitor and manage these fuels, as well as the health of installed systems, will have a major impact on the acceptance of these volatile fuels as safe alternative energy sources. The ability to multiplex many sensors on a single fiber will enable safer and more economical penetrations in cryogenic walls and the low corrosion potential of the fibers will enable sensors to be placed along piping underground. The same basic active fiber sensor technology has the potential to be extended to fuel flow and other economically useful functions.

Lenterra Inc

Phase II Award No.: 0956631

Award Amount: $494,861.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Shear Stress Sensor Based on Optical Micro-Spring Technology

This Small Business Innovation Research (SBIR) Phase II project is aimed at the development of a wall shear stress sensor based on micro-optical resonators. The core element of the sensor, the micro-optical stress gauge (MOSG), consists of a micro-optical spherical resonator and optical fibers through which tunable laser light is coupled into and out of the sphere. By monitoring shifts of the resonator spectrum, that are a function of the deformation of the sphere, forces can be measured over more than four orders of magnitude with minute deformation of the resonator (< 1 nm). This capability allows a MOSG to be incorporated within a shear stress sensor in which the motion of a floating element in contact with the fluid is minimal. In Phase I, a breadboard version of the sensor was fabricated and successfully tested in a model flow between two parallel plates, where measurements were in close agreement with computational predictions. Phase II research will focus on advancing the technology by improving measurement rate, sensitivity, and dynamic range, along with decreasing vibration susceptibility, and improving robustness. Sensor prototypes will be tested on high shear industrial mixers with the aim of commercialization for the process mixing market.

The broader impact/commercial potential of this project will include the advancement of the understanding of the fundamental processes occurring in boundary layers of flows. For non-Newtonian or otherwise rheologically complex fluids, wall shear stress cannot be reliably calculated or, especially for non-transparent flows, measured. The proposed sensor fills a need for shear stress measurement in the fields of fluid dynamics, aerodynamics and medical research. The largest impact is expected to be in the chemical and pharmaceutical industries that are suffering from an inability to scale and predict processing equipment performance. Knowledge of wall shear stress will provide means to improve process control, quality and throughput of products including drugs and other pharmaceutical products, foods, paints, inks and dyes, cosmetics, and many others.

LHC2 Inc.

Phase II Award No.: 0956880

Award Amount: $451,766.00

Start Date: March 1, 2010
End Date: February 29, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Smart Antenna Systems for Unlicensed ISM-band Public Safety and Remote Meter Reading Data Networks

This Small Business Technology Transfer (STTR) Phase II project will develop high performance, low-cost, interference filtering smart-antenna prototypes, anticipated to improve Signal to Interference Ratios (SIR) by up to 12dB. This results in improved wireless data rates by up to a factor of 4 or expands coverage by up to a factor of 16, dramatically reducing system costs. Private wireless broadband networks, deployed by municipalities and utilities are used for public safety, public Internet access, and energy and water management. These networks are experiencing dramatic growth in both size and number. This growth, along with expanding enterprise and consumer use of overlapping devices and Wireless Local Area Networks (WLANs), continue to exacerbate performance reducing interference problems. This interference has forced many municipalities to double their investments in infrastructure equipment or to increase transmitter power to overcome interference, thus producing even more interference. Phase II objectives are to demonstrate technology effectiveness and conduct customer trials. Tasks include; antenna structure refinement, transceiver design, smart antenna algorithm development and packaging for customer trials. Customer trials will be performed in one or more of the target markets. Full commercialization of resulting low cost smart antenna systems is targeted for Phase III.

The broader impact/commercial potential of this project is to ultimately save lives, reduce suffering and save taxpayer/ratepayer dollars through efficient and reliable wireless data communications. For example, public safety and first responder personnel need detailed information such as, interactive live video, voice and vitals monitoring allowing emergency room physicians to interact with disaster victims and their caregivers at the scene and during transport. Utilities must respond, along with emergency personnel, to secure downed power lines, broken gas and water lines and restore physical communications networks. Outage and leak information is increasingly transmitted over critical wireless infrastructure. Public safety networks, based on the WiMAX standard, are expected to surpass $3B in sales by 2013. "Smart Meter" networks are also projected to grow to over $3B in sales by 2013. This unique smart antenna technology will restore otherwise non operating or degraded networks to operational status and help insure that private municipal wireless networks provide reliable high data rates that continue to meet performance goals as the frequencies they use become more crowded. This project will increase the research capability of the partner university's antenna laboratory and engineering science will be advanced through developing a unique smart antenna radiated measurement instruments.

Maxwell Sensors Inc.

Phase II Award No.: 0923921

Award Amount: $500,000.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: Electronic Systems and Instruments

STTR Phase II: Zero-Power Radio Frequency Identification (RFID) Sensing Tags

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project focuses on developing a smart sensor network integrated with Zero-Power Radio Frequency Identification - Sensing Tags (RFID-ST) that combines the technology of a digital Microelectronic Mechanical System (MEMS) switch and a Radio Frequency (RF) antenna for a wide variety of distributed sensor applications. While micro sensor technologies appear very promising, most existing sensors are energy hungry and have a very short battery life. The RFID-ST, however, requires no dedicated power source; rather, after selective detection of special agents of interest, this tiny, low cost sensor reports back the signal when it is interrogated by an RF reader/transducer. During this project, a zero-power RFID sensor tag will be developed with temperature sensors for blood supply applications. The resulting tag will improve transfusion safety by identifying each blood product, virtually eliminating the possibility of mix-up. The tag will also be equipped with a temperature sensor to enable continuous monitoring of the cooling chain.

The broader impacts of this research will allow the resulting wireless sensors to be strategically deployed virtually anywhere: blood supply, cooling chain products, homeland security, border and transportation security efforts, various toxic gases, biological threat agents, explosives, and environmental pathogens. Environmental and regulatory uses exist in the detection of chemical leaks, contaminants, and illegal storage of hazardous materials; and RFID-ST technology would allow industrial users to monitor chemical storage and processing systems.

Motion Control, Inc.

Phase II Award No.: 0924014

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: A Multi-Grip Prosthetic Hand

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will combine lighter weight and quiet piezoelectric technology into an innovative Multi-Grip Prosthetic Hand. Current prosthetic hands are too heavy for many wearers, require expensive cosmetic shells and gloves which are damaged in rugged work environments, and are limited in orientation and gripping capabilities. This project will develop a quiet and lighter weight actuation system and integrate it into a new prosthetic hand design that will be rugged and water resistant, increasing function with a two-position thumb for greater gripping capabilities, and a flexible wrist to enhance orientation abilities and reduce shock loads transmitted to the wearer's remnant limb.

The broader impacts of this research are that it will result in a Multi-Grip Prosthetic Hand, with water-proof housings and connectors, light-weight motor drive, and two-position thumb design. This hand will offer a type of hand never available before in the prosthetic marketplace. Because of its innovative features, it will open up vocations and working opportunities that were closed to prosthetic hand wearers heretofore. "Return to Work", the goal of Worker's Rehabilitation programs worldwide, will be given a tremendous boost.

Mound Laser & Photonic Center, Inc.

Phase II Award No.: 1058443

Award Amount: $499,734.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: IDT Sensors for Monitoring Wind Energy Infrastructure

This Small Business Innovation Research (SBIR) Phase II project will demonstrate an inspection and monitoring sensor system that addresses the problem of structural evaluation of composite components with an innovative nondestructive evaluation (NDE) sensor system. Composites have always been a challenge for inspection due to their multilayer and anisotropic material construction. This challenge is increased when dealing with wind turbine blades due to their enormous size, construction, strength requirements, operational environment, and safety considerations. The Phase II effort will further upgrade and refine the sensor operational capabilities developed in Phase I. The signal to noise ratio and inspection coverage area (sensor footprint) will be further improved. The system capability will be expanded so that a single control unit can operate and receive data from a networked array of sensor. The sensor system will have application during manufacture to verify part quality, for pre- and post-installation inspection to check for shipping or assembly damage and during the component's service life as a structural health monitor system. These sensors offer the possibility for substantial savings and reduction of downtime as manufacturing defects are discovered at the point of origin, before catastrophic blade failure can occur.

The broader impact/commercial potential of this project will be to facilitate the economical installation and operation of wind energy generators. The U.S. has set a goal of 20% (300GW) of electrical power to be generated from wind by 2030. Based on the typical utility scale turbine (1.5-2.0MW) this translates to having over 500,000 turbine blades in domestic service by 2030. Depending on the wind turbine size, blade costs are $55k to $300k each with a 1.5-2.0MW turbine costing $2-3M to install. The growth of wind energy represents a huge manufacturing challenge to produce, install and maintain the turbine blades. The sensor system developed during this program has the potential to detect defects or damage both early in the supply chain and during the life cycle so that expensive energy capacity downtime or catastrophic tower failures can be avoid. Blade failure is not only a cost issue but also a safety one as well. An accurate method for inspection of complex blade structures can have a major economic impact on the industry. The sensor system being developed also has use in Aerospace and Infrastructure/Bridge applications.

NanoFacture, Inc.

Phase II Award No.: 0956876

Award Amount: $500,000.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Tip Biosensor Array for MRSA Surveillance Testing

This Small Business Technology Transfer (STTR) Phase II project is to develop a prototype biosensor array system for rapid surveillance of Methicillin-Resistant Staphylococcus aureus (MRSA) operated by minimally-trained personnel. MRSA, one of the major bacterial pathogens for healthcare acquired infections (HAI), afflicts overcrowded and understaffed US hospitals. Thus, an urgent need exists for a more rapid, reliable yet affordable testing method for HAI screening. The proposed tip sensor's novel sample concentration mechanism enables rapid screening of whole cells followed by confirmation of genetic signatures. The project implements a proprietary sample concentration mechanism for highly efficient capture and detection of bacterial pathogens in a size-exclusive manner. The novelty of the proposed work involves studying DNA reaction kinetics enhanced by a high-frequency electric field on a high aspect ratio tip. The transformative nature of the proposed biosensing technology enables screening for pathogens and nanoparticles without culture and amplification.

The broader impact/commercial potential of this project is to establish a solid fabrication and detection method for a high-throughput biosensor. The tip sensors offer a specific concentration of whole bacterial cells (screening) and an accelerated DNA detection (confirmation). The proposed method will pave the way to high-throughput screening of pathogens through the specific detection in terms of target-geometry, electric properties, and affinity chemistry. The operation cost and time can be minimized through superior concentration performance. Considering the concentration and detection mechanisms, the tip sensor works as a universal platform for low cost detection of various pathogenic analytes including bacteria and viruses, proteins and nucleic acids in clinical samples. The societal impact of this biosensor platform will fulfill an unmet need to save healthcare costs associated with specific pathogens. The technology would eventually be deployed in resource-limited settings including individual uses, for the detection of various pathogens. Thus, this technology will directly impact the fields of micro/nanochip fabrication, biomedical sensors, and low-cost diagnostics.

Neocera Inc.

Phase II Award No.: 0924610

Award Amount: $456,379.00

Start Date: September 15, 2009
End Date: August 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: Fault Isolation of Open Circuits in Semiconductor Products using Magnetic Current Imaging

This Small Business Innovation Research (SBIR) Phase II research project will enable detection of open circuit failures in semiconductor packages and integrated circuits with an accuracy of 10 microns by extending capabilities of magnetic current imaging. This has been one of the most difficult problems encountered by the industry today due to increasing complexity and shrinking of leading edge designs. The only technique available today is time domain reflectometry with practical resolution of 1-2 mm and time consuming layer-by-layer deprocessing. There is a critical need for a faster, non-destructive and more reliable technique capable of locating opens at a level commensurate with package level wiring approaching 10 microns pitch. It is proposed to use magnetic current imaging with a Superconducting Quantum Interference Device (SQUID) to solve this critical need by analyzing high frequency signals effects at the defect location. It is expected that this approach will be able to detect opens with a resolution of about 10 microns.

The broader impacts of this research are: it will enable semiconductor companies to bring product to market faster and with greater reliability by rapidly finding and eliminating sources of open defects; it will benefit the nation by accelerating the introduction of advanced electronics that continuously improve quality of life for consumers, and bring opportunity gains that enhance the competitiveness of American industry.

Perpetua Power Source Technologies, Inc.

Phase II Award No.: 1058551

Award Amount: $499,984.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Flexible Thin-Film Thermoelectric Wearable Energy Harvester

This Small Business Innovation Research (SBIR) Phase II project addresses the need for renewably powered and always available energy for powering personal medical and other location aware sensors. The project advances wearable thermoelectric generator (WTEG) technology. The system will yield new advances in terms of miniaturization, increases in WTEG power densities, application of advanced heat transfer materials, and integration with cutting edge locator system electronics. The research focuses on matching the thermal resistance of the thermoelectric generator with the thermal resistance of the skin to air interface, accomplished through the optimization of thermocouple geometries implemented in thin film semiconductors applied to a flexible polyimide substrate. The anticipated result of the research will be a fully functional wristband locator system that is lightweight, adjustable, waterproof, and renewably powered from the human body.

The broader impact/commercial potential of this project includes applications for location tracking of Alzheimer's patients, nursing home patients, and elderly home healthcare. As our population ages, achieving a balance between personal independence while providing for primary healthcare monitoring will be critical. Wearable thermoelectric generator technology can be used to power wireless sensors that monitor patient location and help facilities track at risk residents. Additionally, wireless sensors can help healthcare providers improve treatment, increase efficiency, and cut costs. A wide range of other follow-on medical applications include glucose monitoring for diabetic treatment and care, diagnosing sleep disorders, and the physiological monitoring of first responders, law enforcement, and soldiers. Each of these applications has been limited by finite and limited battery life. Harvesting body heat and converting to usable electrical energy opens up a new era of autonomous wearable devices.

PHARAD LLC

Phase II Award No.: 0924028

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Electronic Systems and Instruments

STTR Phase II: Optical Fiber Distributed 60 GHz Wireless Personal Area Network

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project will create novel technologies for the realization of a cost-effective, optical fiber distributed 60 Gigahertz (GHz) wireless personal area network (WPAN). The 60 GHz frequency region for wireless communications is attracting much interest worldwide because of the huge bandwidth it can provide. The integration of a 60 GHz WPAN with a fiber-optic signal distribution scheme will enable the required high data rate signals to be efficiently and cost-effectively delivered to a large number of radio access points ensuring optimized radio coverage. A cost-effective prototype wireless access point for a fiber distributed 60 GHz WPAN will be developed and multi-gigabit-per-second (Gb/s) bi-directional data transmission demonstrated. Consumers will directly benefit from the fiber distributed 60 GHz WPAN through the provision of new communication services and the increased affordability in gaining access to unprecedented multi-Gb/s data rate tetherless connectivity.

The broader impacts of this research are the advancement of high data rate communication systems through the deployment of new integrated wired and wireless infrastructures with enhanced flexibility and scalability. The technologies created in this project will also greatly enhance the security of data on wireless networks due to the inherent security in the physical layer of the 60 GHz wireless network. The enhanced security of short range 60 GHz wireless networks will be of direct benefit to organizations such as law enforcement agencies, homeland security, financial institutions and medical institutions, for which the secure transmission of data is critical in ensuring the protection of individuals.

Potomac Photonics Inc

Phase II Award No.: 1058133

Award Amount: $499,801.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Energy Storage, Electrical Distribution, and Packaging for Wireless Sensor Networks

This Small Business Innovation Research Phase II Project targets development of a new approach to building wireless sensor infrastructure - energy storage systems, electrical distribution, and packaging - that allows dramatic miniaturization of wireless sensor nodes, eliminates most restrictions on their shape and is environmentally-friendly. Accomplishing these goals requires development of innovative new approaches to fabrication of mesoscale electronic circuitry and thin film energy storage batteries. Laser-based approaches to making very fine feature conductor patterns, vias, and mechanical structures in a variety of organic and inorganic materials commonly used in the electronics industry will be utilized. New battery chemistry will also be refined to allow fabrication of miniature, flexible, thin film batteries with energy storage densities substantially exceeding those of any battery currently on the market. Together these innovations will allow nearly an order of magnitude reduction in volume of wireless sensing devices. Combination of the laser processing and battery technologies developed in this project will offer an approach to miniaturization of almost any wireless sensor that is easily adaptable to most sensor designs.

The broader impact/commercial potential of this project will be found in many areas of everyday life. After an extended incubation period, wireless sensing networks are experiencing a surge of market growth. A market opportunity for more than 100 million sensor nodes is projected for 2019. Potential applications come from areas as diverse as infrastructure monitoring for bridges, roadways and pipelines, lighting and HVAC control in buildings, electrical metering, parking management, patient monitoring, elderly care, seismic sensors, industrial process control, crop water management, and home automation. In the health care area alone, wireless sensor networks could potentially produce and estimated $25 billion savings world wide. Feasibility of many potential applications will be strongly influenced by the availability of miniaturized sensor nodes with suitable form factors that can be operated without maintenance for extended periods. Targeting miniaturization and power sources, the proposed project addresses and solves key historical bottlenecks in sensor network implementation. It will have a significant impact on these large developing markets, as well as spin-off applications in medical and consumer electronics.

QM Power, Inc

Phase II Award No.: 0956630

Award Amount: $458,194.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Novel Low-Cost Electric Motors for Variable Speed Applications

This Small Business Innovation Research (SBIR) Phase II project furthers the research and development of a completely new low cost high efficiency electric motor for use in HVAC compressors and transportation (electric and hybrid electric) power trains. Parallel Magnetic Circuit ("PMC") technology is a breakthrough magnetic force control technology that is applicable to any electromagnetic device. Unlike alternative existing/conventional electric motors, which use series magnetic circuits limited by the flux density of the most powerful single magnet element, PMC moves flux from multiple permanent magnets and field coils into a coherent and additive geometry - dramatically increasing both efficiency and power density. The increased power density, efficiency and operating speeds intrinsic to PMC designs are enabling performance characteristics for HVAC and transportation systems providing lower cost, smaller, lighter weight, faster and more reliable alternatives.

The broader impact/commercial potential of this project is to improve the efficiency of over $500 billion a year in electricity usage by up to 10% or more, the potential reduction of over 20% of the world's coal fired electricity generation and the potential elimination of up to 30% of global CO2 emissions. Higher energy prices and usage have accelerated the growing global demand for lower cost energy efficient products. Since over 50% of all global electricity is consumed in electric motor systems and over 26% of fossil fuels are used in transportation applications, it provides a significant opportunity to reduce energy costs, pollution and national security concerns. PMC motors can be used to significantly increase the efficiency and lower the cost of all electric motor driven systems including electric and hybrid electric vehicles, HVAC systems, industrial, consumer, military applications.

REHABTEK LLC

Phase II Award No.: 1058612

Award Amount: $499,991.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Developing a Pivoting-sliding Elliptical Machine for Knee Injury Prevention/Rehabilitation

This Small Business Innovation Research (SBIR) Phase II project develops a new exercise device for neuromuscular training about the minor/secondary axes to reduce and prevent lower-limb injuries. Considering joints in the lower-limb including knee and ankle are free to flex-extend but with much more limited motions about the minor/secondary axes (leg twisting and side sway at the knee and ankle twisting and side sway), injuries often occur with excessive minor/secondary axis loadings. However, there is a lack of convenient and effective devices that can be used to train minor/secondary-axis neuromuscular control of human lower-limb during functional major-axis stepping/running movements. This project will address the strong exercise and clinical needs and develop a unique minor/secondary-axis exercising device to help subjects improve minor/secondary-axis neuromuscular control and rehabilitate/prevent knee/ankle injuries associated with excessive minor/secondary-axes loadings. Practically, this minor/secondary-axis exercising mechanism can be implemented with many existing exercise machines (elliptical machine, stepper, stair climber, bicycles, and leg press machines) for minor/secondary-axis training. As a powerful clinical evaluation tool, this system can also provide quantitative outcome evaluation.

The broader impact/commercial potential of this project includes the novel training modality, widely used exercise platforms, and focused training protocol. The proposed unique minor/secondary-axis neuromuscular training device may directly help reduce various lower limb injuries. Furthermore, it may benefit multiple joints in the human lower (and potentially upper in a similar way) limbs and it may benefit individuals with minor/secondary-axis impairments in neurological disorders as well as musculoskeletal injuries. Similarly, the widely occurring knee osteoarthritis and leading cause of disability is closely associated with unbalanced/improper frontal plane loadings. The proposed minor/secondary-axis training device will provide a general platform and training strategy to help people better deal with potentially injurious off-axis loadings of the whole lower limbs with quantitative outcome evaluations. Practically, the minor/secondary-axis training can be implemented on various common exercise equipment including elliptical machines, steppers, stair climbers, and bicycles. The minor/secondary-axis training device can be used in hospitals/clinics for post-surgery/injury rehabilitation, and in gym and home settings for injury prevention training as well as rehabilitation. People of various ages and at various sports/activity levels can be trained to better prepare for potentially injurious off-axis loadings and avoid potential injuries.

RESENSYS, LLC

Phase II Award No.: 1026903

Award Amount: $499,033.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: An RF Radiation Empowered Sensing Method for Low Cost Structural State Monitoring

This Small Business Innovation Research (SBIR) Phase II project addresses the deteriorating situation with respect to our nation's infrastructure system, particularly bridges. A solution is critically needed to monitor the structural integrity of such systems in order to identify potential failures - such as the Minneapolis I-35W Bridge collapse - before they occur. Existing solutions for structural state sensing are expensive, labor intensive, non-scalable, and unreliable. Phase I demonstrated the feasibility of an innovative, cost-effective, non-intrusive, and scalable structural monitoring technology known as Active RF Test (ART). The investigators developed a prototype of a thin, mechanically flexible, patch-like wireless sensor that can be easily attached to distributed points of a structure. ART sensors are batteryless, with their energy supplied through an in-network RF energy radiation mechanism. Based on the Phase I success, Phase II will (1) optimize the architecture and enhance the capabilities of the ART sensors; (2) develop cost effective processes for high-volume production of the sensors; (3) develop analytical tools that generate a map of installation locations for ART sensors on a structure; (4) develop detection/diagnostics models based on the sensors; and (5) conduct a field evaluation of the ART system on two highway bridges.

The broader impact/commercial potential of this project is protecting the US infrastructure against aging, structural malfunction, and failures. Aging infrastructure poses a significant societal challenge: recent reports indicate that the US transportation infrastructure has 601,027 bridges, of which 71,419 are structurally deficient. Unique features of the proposed ART technology - such as easy installation, low cost, scalability, energy self sufficiency, and durability - make it an ideal response to this challenge. The attachment of ART patch sensors will be non-intrusive to a structure, the installation effort will be minimal, and no drilling will be required. The mechanical flexibility of the ART patch sensors will allow adaption to complex geometries, including bearing plates, gusset plates, joints, support cables, and truss systems on a bridge. Finally, ART technology features a multipurpose solution that can be tailored to structural integrity monitoring needs of different types of structures, including bridges, pipelines, dams, airframes, and offshore platforms. The 71, 419 structurally deficient US bridges alone represent a commercial market of $2.8 billion. The potential to address other structures, along with the potential for international sales, would enhance the opportunity.

Resonant Sensors Incorporated

Phase II Award No.: 0724407
Phase IIB Award No.: 0944225

Award Amount: $900,000.00

Start Date: July 15, 2007
End Date: June 30, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: Development of Resonant Waveguide-Grating Elements for High Throughput Screening of Proteins

This Small Business Inovation Research (SBIR) Phase II research project applies a new sensor principle to develop commercial High-Throughput Screening (HTS) systems for drug-development applications. The advantages of the Guided-Mode Resonance (GMR) sensor concept for such applications reside in its inherent physical characteristics including polarization diversity, materials independence, choice of spectral regions, angular-addressing flexibility, and associated compact system configurations. These properties enable tag-free sensor technology with high sensitivity, high accuracy, and multi-parameter detection. A major objective is the development and verification of GMR-sensor HTS commercial system prototypes in standard formats. Integrated analysis software will present data on biomolecular binding events, including background density and molecular accumulation dynamics, to the user. An additional main thrust is the development of attachment chemistry and methods for sensor activation where a set of protocols and processes for example measurands will be optimized to maximize detection sensitivity. Finally, by applying transmission sensor formats with shaped input light beams and integrated detector matrices, the next-generation compact system designs for massively parallel screening of drug compounds will be provided.

This research project will stimulate progress in drug discovery. Guided-mode resonance sensors operate without chemical tags permitting observation and study of unperturbed biochemical processes, as no foreign substance is introduced. Therefore, these sensors provide enhanced understanding of chemical and biomolecular reactions and may lead to advances in chemical process development and drug discovery and design. Moreover, this class of biosensors has other potential applications including medical diagnostics, proteomics, genomics, environmental monitoring, and homeland security. Application of this technology to microfluidics, lab-on-a-chip, and wireless integrated sensors for homeland security and environmental monitoring may provide new tools for accurate and cost-effective detection of biotoxins, explosives, and hazardous materials.

Sensys Networks, Inc.

Phase II Award No.: 1057566

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Wireless Weigh-in-Motion

This Small Business Innovation Research (SBIR) Phase II project will develop a fully functional prototype of an accelerometer-based wireless Weigh In Motion (WIM) station. The WIM system will comprise an array of battery-powered 3" cubes, embedded in the pavement, each consisting of an accelerometer, a microprocessor for local signal processing, and a radio that sends the processed measurements to an Access Point (AP) on the side of the road. The AP estimates the pavement load from each axle of a truck at freeway speeds and the truck's class, and transmits these estimates to the traffic management center. The cubes take up minimal space and are installed within minutes, so WIM systems can be deployed anywhere at a fraction of the cost of traditional WIM stations. Phase I research demonstrated the technical feasibility and commercial potential of the WIM. The technical objectives of Phase II concern the WIM packaging and installation; calibration: sensitivity to weight, speed and temperature (especially for asphalt pavements); signal compression and source coding; channel coding; wide area data backhaul; overall system design; manufacturing prototype samples; and extensive testing.

The broader impact/commercial potential of this project is to dramatically enhance the regulation of truck weights and provide data to greatly improve the maintenance of the US road and bridge infrastructure by drastically reducing the costs of WIM stations. Current WIM stations have limited deployment as they are costly to install requiring shutting the road for days and needing expensive maintenance and re-calibration. The new WIM stations could be widely deployed in additional locations on arterial streets and near ports to monitor truck traffic and be a component in a truck weight-based enforcement and toll system. These WIM stations could also meet similar objectives in overseas markets creating employment for US residents with diverse skills in the design, manufacturing, sales, and installation.

SpringActive, Inc.

Phase II Award No.: 0956828

Award Amount: $500,000.00

Start Date: Febrary 1, 2010
End Date: January 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Compliant Jack Spring Actuators for Lower Limb Mobility

This Small Business Innovation Research (SBIR) Phase II project will develop a novel, spring-based, adjustable stiffness actuator, that will power future wearable robots and exoskeletons. The actuator will be integrated into a powered prosthetic ankle which will meet the demanding requirements for lower limb mobility. Its unique ability to tune stiffness allows it to be customized to an individual, a significant impact in the wearable robotics field. It will meet the demanding design requirements that include the tradeoffs between high power need, low energy usage, compliance, robust sensing of forces, and high cycle demands. The end result is a powered ankle-foot prosthesis that will provide near able-bodied function to a lower leg amputee.

The broader impact/commercial potential of this project is that it will restore normal walking function to below-the-knee amputees. Such a device will increase symmetry and duration of walking. In fact, a below-the-knee amputee wearing a passive prosthetic device typically uses 20-30% more energy to walk than an able bodied walker. Asymmetry in an amputees gait leads to joint pain, arthritis, and back pain. Because of the difficulty to walk, their conditions often lead to a more sedentary lifestyle decreasing their already limited mobility. It is documented that decreased mobility increases health risks. Elderly or overweight individuals may benefit from the technology as well. Adaptation of the technology to the powered orthosis market will expand its benefits to weak and disabled populations. In general, these groups have a more sedentary lifestyle and sometimes rely on the use of powered scooters. Because of the growing population of people with diabetes, elderly, and individuals with reduced walking ability, powered lower-limb robots will have a significant societal impact improving health by supporting an active lifestyle.

Square One Systems Design, Inc.

Phase II Award No.: 0923850

Award Amount: $506,695.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Electronic Systems and Instruments

SBIR Phase II: Combining Mobility and Manipulation in a Tri-Sphere Robot

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II research project seeks to develop a radically new type of mobile robot. Most of today's robots rely on wheels to move from one location to another but the proposed Tri-Sphere robot moves by walking. This form of locomotion provides distinct advantages when the robot is called upon to negotiate cluttered terrain. The Tri-Sphere robot interacts with its environment via a unique six degree-of-freedom parallel manipulator. This manipulator allows the robot to dig, grasp and carry objects with exceptional dexterity. An important feature of the robot's design is that both its manipulator and its legs are driven by the same suite of six electric motors. This intrinsic mechanical simplicity results in an extremely robust mechanism well suited for dirty, difficult jobs.

The broader impact of this research is the creation of a new class of robots designed to combat the threat posed by land mines and other explosive devices. It is estimated that more than 60 million mines are in place throughout the world. The Tri-Sphere robot will provide a safe, reliable means of locating, unearthing and disposing of this unexplored ordnance. In addition, the Tri-Sphere design can be scaled to create versions of the robot tailored to the demands of mining, underwater trenching and other complex material handling operations that must be conducted in hazardous environments.

TagArray Incorporated

Phase II Award No.: 0822542
Phase IIB Award No.: 1049020

Award Amount: $1,000,000.00

Start Date: July 1, 2008
End Date: December 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Clock-on-Demand: High Performance, Ultra Low Power

This Small Business Innovation Research (SBIR) Phase II research project is to develop a prototype and proof of concept for the tag and reader that uses an innovative low power Clock-on-Demand (CoD) and baseband/ media access controller (MAC) calibration algorithm to be used with ultra wideband communication systems. The new CoD and algorithm are motivated by application of ultra wideband to the RFID (Radio Frequency Identification) market. In this prototype, the CoD and the baseband/MAC layer algorithm are implemented in standard CMOS for tag and the UWB receiver and narrowband receiver with discrete components for reader. The low power requirement is achieved by the CoD and by dividing the time into epochs and epochs into slots. The CoD only runs until the tag transmits its impulse in the relevant slot, and the reader decodes the ID representations of all tags by the slot number. Therefore, if an epoch is divided into 210 slots, an impulse by tag represents 10 bits of the information. The robustness is achieved by having an UWB impulse transmitter in the tag and by repeating the impulse in different epochs.

RFID is an exponentially growing market. However, the technology that supports its expansion is not able to provide robust communication and signaling between a tag and a reader. Furthermore, today's technology only supports a low tag density (10s of tags/sec), while the applications that will fuel the exponential expansion of the RFID market, like point-of-sale, inventory management, shelf management, etc., require 100s and 1000s of tags/sec.

XW, LLC

Phase II Award No.: 1058599

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Ubiquitous Landline-Based Long-Reach Broadband Access

This Small Business Innovation Research (SBIR) Phase II project targets significantly increased throughputs and distances for broadband access over the existing copper landline infrastructure at low cost. In particular, the technology being developed offers advantages in interference-dominated and in suburban/rural environments. In the USA alone there are many millions of households that are currently out-of-reach of broadband access, where there are typically multiple copper landlines available, and the global demand for such solution is significantly higher. For these underserved subscribers, this innovative extended-reach solution represents the only low-cost broadband access alternative to costly, inefficient satellite coverage. While existing Digital-Subscriber-Line (DSL) solutions are not specified to provide broadband access at very long distances, the company's novel solution greatly increases the achievable distances and allows broadband rates (1Mbps) to be delivered at extended ranges, as demonstrated in Phase 1 of this project. The technology combines innovative signal-processing algorithms with novel digital implementation architectures to allow for high-performance reduced-complexity and low current-consumption implementations.

The broader impact and commercial potential of this project are in enabling affordable broadband service to the many households, which are currently out of the reach of broadband access, and in enhancing the performance of other copper-based applications. The technology will enable telco providers to better compete in areas where cable service exists, and can enhance existing solutions for copper-based backhaul, thereby helping service providers with the growing problem of backhaul bottlenecks associated with increased wireless traffic. The growing demand for solutions of this type has the potential to generate annual revenues on the order of $50M, representing a great business opportunity. Societal benefits include providing broadband service to previously-unreachable homes, thus allowing them to engage in remote education, e-commerce, and telecommuting, with all of the advantages that these entail. Ongoing collaborative research with local universities is serving to steer academic research in this field towards the actual needs and interests expressed by service providers, thus advancing the related fields in communication theory and circuitry design and involving students in this research.

2Cimple Inc

Phase II Award No.: 1026539

Award Amount: $499,980.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Interactive video based Contextual & Dynamic Application Access

This Small Business Innovation Research (SBIR) Phase II project will address a significant problem for Video Publishers: How to enhance the monetization of online video content. Online video is more than doubling in consumption year over year (31 billion views in November 2009). However, it is believed that the video publishers are not able to fully capitalize on this massive online video trend because they are using a single source revenue model via Pre-, Mid- and Post-Roll advertising that has limited revenue opportunity, declining prices, and negative viewer experiences. 2Cimple is developing a solution, an Interactive Video Applications Platform that has the potential to increase a publisher's online video revenue. This platform, dynamically associates and pushes relevant interactive video applications to consumers while providing a "user-controlled" opt-in environment that results in a higher degree of viewer experience and engagement. The platform is built on flexible and scalable client-server architecture based on industry-standard technology components. The technology uniqueness includes a dynamically configurable Video Player, an application server capable of automatic video context detection and dynamic application insertion, an open application development platform, integrated video and application analytics, customized reports, and a simplified management system.

If successful, the platform has commercialization potential that introduces efficiency into the online video value chain by increasing revenue for publishers, optimizing budgets for sponsors, and providing a higher degree of engagement and enhanced viewing experience for consumers. This platform will enable a new web-based eco-system built around online video that will spur advancements and innovation in video and software technologies and provide economical benefits to all participants. The platform provides a brand new engagement model enabling "user-controlled" contextually relevant, dynamically-inserted, call-to-action applications and other rich media experiences.

422 Group

Phase II Award No.: 0956891

Award Amount: $500,000.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: An Innovative and More Effective Means to Manage the Communication Process Between Colleges and Prospective Students

This Small Business Innovation Research (SBIR) Phase II project proposes to commercialize a predictive modeling technology that automatically adapts to changing interaction patterns between providers of higher education (colleges and universities) and consumers (prospective students). Current methods produce only retrospective static models which, due to peculiarities of the higher education recruitment cycle, require at least a one-year lag between data acquisition and application to new prospects. As a result, data mining techniques have gained only limited popularity in college recruiting. The approach proposed here employs a proprietary adaptive modeling engine (AME) to leverage real-time transactional data from a CRM system and dynamically update scoring algorithms to predict outcomes. AME relies on a logical interface and unified dimensional data model to extract analyzable record-sets accurately representing the state of underlying transactional data at any time-slice within the system's effective-dated range. The integration of these key technologies allow relationship patterns to be identified in the recruitment process as they occur and scoring algorithms to dynamically adapt to changing patterns within a single recruitment cycle.

It is believed that the changing demographics of college-going students will present a number of significant obstacles to the traditional college business model and could jeopardize the future financial health of many higher education providers in this county. The decade-long trend of yearly increases in demand, as represented by the number of new students entering college, comes to an end in 2009. In stark contrast to the 24% growth the market has experienced over the past decade, future enrollment numbers will remain stagnant overall, and in many localities college enrollment will actually decline. Furthermore, dramatic shifts are coming in the geodemographic, ethnic, and cultural mix of high school graduates that feed the higher education market. As competition for students increases dramatically in the face of rising attendance costs, dwindling endowments, changing demographics, and a decline in college-bound students, each college's ability to survive, much less prosper, will depend directly on its ability to identify, understand, and communicate with students in a more efficient and cost-effective manner. Those that are able to adapt this new landscape through the use of innovative tools like AME will flourish, and those who are unable to adapt will face an uncertain future of declining enrollments and financial instability.

APP2YOU

Phase II Award No.: 0956905

Award Amount: $471,495.00

Start Date: April 15, 2010
End Date: March 31, 2012

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Sector: IT Applications

SBIR Phase II: Do-It-Yourself database-driven web applications from high level specifications

This Small Business Innovation Research (SBIR) Phase II proposal discusses the continued commercialization and research & development plans of App2You, Inc., developer of a Web-based platform that enables non-programmers to rapidly create and evolve fully custom hosted forms-driven workflow applications where users with different roles and rights interact. Such a platform will have a broad impact on organizations of all sizes by empowering nonprogrammer business process owners to quickly and easily deploy applications that capture the business processes of their organizations. Preliminary results from Phase I engagements shows that the platform has the maximum impact on enabling externally-facing Customer Relationship Management (CRM) for Small and Medium Businesses (SMBs), which use the applications to facilitate and streamline interactions with customers and partners, achieve lower process management and customer/partner servicing costs, increase customer/partner satisfaction and grow revenues.

App2You has the potential to operate as an equalizer between large companies and SMBs with limited time and money available to for their IT infrastructure, since it enables the latter to obtain applications for their processes despite limited resources. Phase II will expand the impact by systematically reaching SMBs and promoting the use of the platform, making its use even simpler, and also finding additional verticals, such as forms distributorships and form abandonment cases, where forms-driven workflows can generate values. Finally the Phase II project will create enhancements that facilitate successful collaborations between business process owners and ad hoc information technology staff. If successful, the App2You platform has the potential to address an emerging and potentially significant opportunity in the SMB space.

ARTBOX LLC

Phase II Award No.: 0924692

Award Amount: $530,000.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: IT Applications

SBIR Phase II: Method of Integrated Web-Based Tools to Enable a Collaborative Community of Professional Creatives

This Small Business Innovation Research (SBIR) Phase II project provides an integrated suite of Web-based applications to an online network of professionals in the creative industries. These professionals include Creatives such as writers, photographers, illustrators, filmmakers, animators, product designers, programmers and producers. The products of their creative activities include both commercial and fine-arts applications in the realms of music, literature, imagery, audio-visuals, communications and product design. The end users of these products range from the personal consumer to global industry, education and government. This innovation builds on the software-as-a-service tools developed through Phase I efforts and brings them to their next evolutionary level. Tools to enable collaboration and commerce among subscribers to the site will be developed and released. With these tools and its network of cultural entrepreneurs, Artbox.com establishes a 21st-century internet agora, in which talented, accomplished thinkers-and-makers assemble to trade their ideas and inventions.

Independent Creatives, the driving force behind the growing Creative Industries, have demonstrated a need and desire for the kind of solutions that this innovation intends to provide. The Internet has changed the economic realities of almost every business, and the American economy is at a turning point. Old models based on manufacturing and information technology have been greatly affected by the availability of cheap labor overseas. Observers of these trends have identified that "innovation," "imagination" and "collective intelligence" form the new basis for competitive advantage in the global marketplace. In an innovation economy, creators of original content, concepts and products are also the creators of value. If successful, Artbox.com will build a powerful network and efficient talent-sourcing tool for businesses and individuals alike.

Bioproduction Group, Inc.

Phase II Award No.: 1052566

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: Enterprise Decision making using Activity Interaction technology

This Small Business Innovation Research (SBIR) Phase II project seeks to further research and implement a Network Algorithm for efficiently running large-scale network simulations and using those simulations to perform enterprise planning and risk analysis. The company's algorithms (and associated early-release software) have been shown to run supply chain models one order of magnitude faster, with one order of magnitude more complexity, than current simulation models commonly deployed. Bioproduction Group has created a simulation methodology that meaningfully links together highly-detailed operational level models with its large network-scale model. Each operations simulation is linked by network relationships such as supply and demand, product path flows, and inventory holding centers.

Bioproduction Group has received contracts with several biotech firms to implement advanced prototypes of this research in biopharmaceutical manufacturing as they come online. The goal is to use this simulator to reduce biopharmaceutical inventory levels across the industry by 10% or more, while reducing risk across the manufacturing network. If successfully deployed in a large enterprise, it is believed that this inventory reduction would have a yearly return of more than $20mm per organization. The technology has the potential to be used across the biopharmaceutical industry to increase quality of care to the patient as well as reduce manufacturing costs. These goals have significant direct flow-on savings benefits to the hundreds of thousands of patients across the entire public and private healthcare sector.

Bluefin Lab, Inc.

Phase II Award No.: 0923926
Phase IIB Award No.: 1114405

Award Amount: $997,550.00

Start Date: August 15, 2009
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Semi-Automated Sports Video Search

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The Small Business Innovation Research (SBIR) Phase II project objective is to commercialize a novel technology for indexing video. The company's approach automatically integrates information from speech, text, and video through algorithms that generate rich semantic indexes for video. The Phase I results show that this approach can be incorporated into a system that indexes video with high accuracy and at a fraction of the cost of currently used methods. Further, during the Phase I research, the company has identified a large and growing consumer market (sports video) in which the technology can be applied.

The technical objectives of the Phase II proposal focus on working with such partners to roll out initial Bluefin-powered applications, such as content-based search and video-enriched fantasy sports. Such applications are currently not feasible because of the low accuracy of automated indexing methods and the high cost of manual approaches to indexing video. Millions of hours of new video content are coming online every month, feeding an exploding demand and reshaping the nature of the Internet. Just as text-oriented search engines were necessary to empower users to find what they needed during the first phase of the text-centric Internet, a new generation of technology will be necessary to organize and effectively find content in the fast-approaching video-dominated era of the Internet. Bluefin Lab is pioneering a new approach to video organization and search by commercializing cross-modal algorithms developed in Academe. While this differentiated technology can be leveraged in several target markets, the company's initial focus is on sports media where it will power a unique experience for video search, video-enhanced fantasy sports, and other video-centric applications.

Crosscut Media, LLC

Phase II Award No.: 0847999
Phase IIB Award No.: 1127142

Award Amount: $601,500.00

Start Date: February 1, 2009
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: Applying Latent Group Models to Web Publishing

This Small Business Innovation Research (SBIR) Phase II project will extend the work begun in Phase I to apply advances in knowledge discovery to bridge the gap between what is known about an Internet viewer and what is done with this knowledge to improve user experience and business outcomes. The effort will develop new algorithms to combine implicit and explicit taxonomies to build content networks. A live feedback loop that uses multivariate test results will be used to adjust and refine clusters of users in order to establish specific parameters which can subsequently be acted on.

Online content publishers aggregate enormous volumes of data about their viewers from web logs, registration systems, third-party web analytics providers and ad-serving systems. Mostly these systems operate independently with a primary focus on describing what has happened. Through a deeper analysis, which will be enabled by the current effort, content providers will be able to use this data in more predictive ways. This in turn will allow content providers a more intelligent tool for serving higher-value content throughout the online experience. If successful, this will have implication for new rich media services and e-commerce.

EMOTA.NET

Phase II Award No.: 1058575

Award Amount: $499,992.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: An Internet-based Emotional Connectedness and Monitoring Device and Service for the Elderly

This Small Business Innovation Research (SBIR) Phase II research project will develop to market a new class of assistive technologies to improve the quality of life and well being of the elderly and to reduce the overall burden of the of aging on social and private healthcare systems. The company envisions the digital transformation of the aging process through the application of emerging technologies to change the context of caregiving from a medical to a familial one. Today's telehealth solutions focus on medical aspects and ignore social and psychological needs - a sense of contribution and connection for older adults. Research has shown that social isolation significantly increases the health risks. Conversely, even small increases in perceived emotional support result in significant improvement. The proposed platform has the potential to integrate with existing Health IT and telehealth systems to provide a holistic patient-centric solution, focusing not just on medical needs, but on the emotional and social aspects of aging.

Three powerful market forces intersect to create a new context in elder care: (1) Reducing rehospitalization has become a National priority, (2) New recognition that family caregiving needs to be an integral part of health care, and (3) Significant shift in age mass. One in five seniors discharged from hospitals is readmitted within the month. Research indicates that a "failing support system appeared to be the most important factor of influence in this respect." The American College of Physicians now encourages doctors to recognize the value of family caregivers as part of the care plan. Supportive social ties enhance physical and mental health among older adults whereas social isolation, loneliness and stressful social ties contribute to a higher risk of disability, poor recovery from illness, and early death. The company believes that there is significant market for consumer-oriented, social-based, self-care solutions that can integrate gracefully with professional medical monitoring solutions. If successful, the effort could kick start an ecosystem of similar, emotional connectedness solutions and technologies that could positively impact the lives of the elderly, and potentially other isolated groups as well.

Guidewire Group

Phase II Award No.: 1058606

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: Web Enabled System to Assess, Mentor and Accelerate Startup Businesses

This Small Business Innovation Research (SBIR) Phase II project will develop a Software-as-a-Service platform to provide Assessment, Discovery, Monitoring, Benchmarking, Comparison, and Promotion of early-stage companies, initially in the information technology and clean energy sectors, in order to provide scalable support with predictable outcomes for entrepreneurs. Guidewire Group is developing the underlying technology platform, assessment methodology, assessment training, automated work plans, curriculum, and portfolio management applications that enable startups and those that work with them to more effectively grow their businesses.

If successfully commercialized, the application stands to significantly scale the delivery of business development and advisory resources to early-stage companies and deliver predictable outcomes that improve a company's likelihood of success. By aggregating assessed data on startups worldwide, the application will provide a global context that enables startups to compete more effectively in world markets and to connect more efficiently with a global Innovation Ecosystem that buys and sells services from and to startup companies. Moreover, by delivering the platform in conjunction with a suite of best practices curriculum and a global community of entrepreneurs, the platform will enable organizations that support and incubate startup companies to more effectively manage and map the training of their companies.

Hevva LLC

Phase II Award No.: 0822889
Phase IIB Award No.: 1051794

Award Amount: $1,000,000.00

Start Date: August 15, 2008
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: SaaS-Based Procurement and CRM Systems for Local Food Markets

This Small Business Innovation Research (SBIR) Phase II project will develop a new methodology for data interchange in the agricultural industry. GreenLeaf Market is developing application program interfaces to enable the automated transfer of data to enterprise resource planning systems through a representational state transfer interface interchangeable with a webservice. This platform automatically identifies and aggregates agricultural market information while enabling this information to be integrated into the purchaser's business systems.

If successfully commercialized, the application stands to significantly reduce post-harvest spoilage costs, now in the tens of billions of dollars for the United States. It will increase productivity for purchasers, assist the producer in identifying emerging markets, reduce the distance agricultural products must travel, boost the local economy, improve the food security of the US, and lower the overall cost of food by reducing the gap between supply and demand.

HOMER Energy LLC

Phase II Award No.: 0954292

Award Amount: $600,000.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Sector: IT Applications

STTR Phase II: Matching the Timing of Renewable Energy Production with Patterns of Electricity Demand

This Small Business Technology Transfer (STTR) Phase II project will transform the Hybrid Optimization Model for Electric Renewables (HOMER®) software into a tool that empowers professionals, students, and industry to design "hybrid" electricity systems that blend renewable resources, which are unpredictably intermittent, and fossil-fueled-based fuels, which are polluting and expensive. As renewable resources become more prevalent due to regulatory requirements, cost decreases, and consumer interest, the numbers and complexities of these hybrid systems will rise. HOMER is a simple, easy-to-learn tool that simulates the permutations of generating equipment in an electrical system to recommend the lowest-cost configuration that satisfies consumer demand. Developed at the National Renewable Energy Lab (NREL) from 1992 to 2007 as a free downloadable application, the software will be converted into a web-based, e-commerce-enabled service (proven feasible in Phase I) as the vital component of HOMER Energy® LLC's growing business selling software, services and community to HOMER users. In addition, as part of this Phase II project, University researchers will apply this new version of HOMER to current, real-world issues relating to energy policy and technology in order to validate the software and promote it as a valuable research tool.

This project has the potential to improve the access, usability, and features of the HOMER® software tool with the following impacts: 1) This easy-to-use modeling tool will assist research on existing, new and conceptual types of electricity generation and storage, as well as their implications on electricity supply and policy. 2) By recommending systems with lower costs and providing more accurate estimates on initial and operating investment, distributed renewable energy will be integrated more rapidly into electrical systems, augmenting or displacing fossil-fuel-based generation with a commensurate reduction in carbon emissions while increasing the reliability and security of electricity supply; 3) The accelerated electrification of rural areas, especially in developing nations, enabled by the tool has the potential to positively impact a region's standard of living.

Imagine Research, Inc

Phase II Award No.: 1026435

Award Amount: $500,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Sound-object Recognition for Real-time or Offline Systems

This Small Business Innovation Research (SBIR) Phase II project includes research and development of audio recognition and analysis software for offline and real-time sound recognition. Musicians and audio engineers have access to terabytes of music loops and sound effects. However, musicians are limited to searching for sounds using text-only keyword searches. This is a mundane, inaccurate, and exhausting process that ignores the files' actual audio content. The proposed solution provides a unique "find-something-that-sounds-like-this" search engine. Media production software and hardware is too complex, tedious, and labor-intensive for both novice and advanced users. The proposed sound platform adds capability that was previously missing - recognizing an input sound and automatically choosing the best parameters for the user. This project uses a signal processing and machine learning platform to perform novel experiments for classifying audio streams in real-time, improving recognition accuracy, and retrieving sounds from large collections. Commercial-quality software development kits for offline and real-time sound recognition will be developed. This project integrates state-of-the-art machine learning, digital signal processing, and information retrieval techniques.

If successful, the platform will be able to listen to an audio signal and understand what it is listening to - as human listeners can identify and classify sounds. This innovative technology will be licensed to audio and music technology software and hardware manufacturers. The platform is suited for long-term discoveries and innovation, with demonstrated commercial interest from biomedical signal processing, security/surveillance, and interactive gaming companies. In the first chosen market, (sound engineering) the platform will have direct cultural benefits for musicians, music hobbyists, and audio engineers. It will allow music creation and audio production to become a completely creative task - minimizing the tedious technical issues that hinder the creative process, and lowering the barriers to entry for novice musicians and creative professionals.

Intelligent Building Untility Conservation Systems

Phase II Award No.: 1058605

Award Amount: $500,000.00

Start Date: May 1, 2011
End Date: April 30, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Isolating Specific Appliance Energy Usage from Whole Building Energy Consumption

This Small Business Innovation Research (SBIR) Phase II project will further develop the IBUCS' Utility Accountant electrical load disaggregation system and conduct performance trials in small commercial settings. Utility ratepayers need granular information to more effectively identify and mitigate inefficient appliances and activities. The new generation of smart electric meters currently being deployed for automated reading and time of use pricing are not be able to provide this level of detail. The signal processing algorithms evaluated during the Phase I study accurately isolate and quantify the power used by individual appliances from the aggregate power signal of the many appliances present on a leg or circuit. In the proposed project, additional enhancements will be made to the load disaggregation algorithm that will significantly improve system accuracy and reliability. Ratepayers will access a secure webpage to view their cost to operate specific appliances in their building or groups of buildings. The granular perspective provided will enable end-users to (1) calculate their own investment return periods for equipment repairs and upgrades, (2) develop data driven best practices for energy conservation, and (3) ensure that cost reductions are maintained over the long term.

The broader impact will occur when the technology is deployed throughout the residential and commercial segments as part of a new generation of smart meters. Commercially-available systems that directly monitor multiple specific loads are more expensive by an order of magnitude and inherently more difficult to install and maintain. Providing appliance specific load information has the potential to transform ratepayers' ability to conserve energy. The intended outcome of this Phase II project is to create an easy-to-use tool that will continually educate small business or franchise operators to reduce energy consumption. Nationally, Quick Serve businesses (i.e. fast-food restaurants, gas stations, and minimarts) account for ~10% of commercial buildings but are generally underserved by energy management companies due to their small size. IBUCS will provide a value-added service to the property manager through an energy management company that serves this segment.

IQ Engines, Inc.

Phase II Award No.: 0822713
Phase IIB Award No.: 1050700

Award Amount: $1,212,000.00

Start Date: August 1, 2008
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Mobile Visual Search Engine

This Small Business Innovation Research Phase II project will develop a biologically-inspired image search and recognition technology to provide rapid object information retrieval from a mobile phone camera. The end result is that potentially any object in the real world is now "clickable": a picture of an object provides a hyperlink to the Internet. The proposed system utilizes a new method for sparse, multi-scale image representation based on the monogenic signal, a 2D generalization of the analytic signal that is robust to image transformations.

By 2010, it is estimated that there will be over 1 billion mobile phones with cameras. The mobile phone is becoming an important connection between people and the digital world. The applications for mobile search technology are enormous and include national homeland security, product information retrieval (such as environmental ratings, pricing, or specifications), vision support for the blind, accessing object information for the disabled, and general purpose information retrieval including remote visual data analysis and inspection. Search technology has brought about many profound societal, educational and scientific benefits in the past decade. The proposed mobile image search technology will extend those benefits to a broader base of users and applications.

JAAL LLC

Phase II Award No.: 0956747

Award Amount: $488,242.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: Making the Internet Safer One Website at a Time

This Small Business Innovation Research (SBIR) Phase II project will develop a novel security capability for protecting websites against hackers by providing preventive and early diagnosis services. Compromising websites is an emerging and profitable business for hackers, with devastating effects since such attacks: (a) hurt the compromised site directly, e.g. stealing stored credit card information, (b) hurt the website visitors, who are subjected to viruses infections or identity theft via code injection, which turns a legitimate website into a distributor of malware, and (c) hurt the reputation of the code-injected website, which is inevitably blacklisted by search engines. The project will develop the technology to: (a) assess the vulnerability level of a website, (b) detect security breaches in the form of code injection, and (c) expedite the recovery of a compromised website. the proposed work focuses on three key goals: (a) massive scalability through the minimization of manual intervention, (b) robustness and manageability by a carefully designed software-hardware architecture, and (c) continuous process of self-improvement and assessment of performance.

If successful, the impact of the proposed project has the potential to be immediate and direct: it promises to make website security more affordable, and not a luxury or an afterthought. Website security is an immediate and expensive problem: (a) it is estimate that most websites (over 60%) are vulnerable, (b) web-based malware spreading is taking the dimensions of a pandemic, (c) all of the reported 74M active websites are likely targets: from banks, to the local cookie store, and ultimately, (d) cyber-crime is a top national security threat according to the government. The proposed solution has the potential to make significant contributions in each of these four areas.

Kaviza Incorporated

Phase II Award No.: 1026875

Award Amount: $499,707.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Next Generation Virtual Desktops

This Small Business Innovation Research (SBIR) Phase II project will focus on scaling and developing a desktop-specific distributed grid to provide enterprise grade, highly available virtual desktop systems that are cost-competitive with PCs. To accomplish this objective the research and development will focus on three key areas. First it will focus on multiple ways to scale the solution including ways to distribute large desktop templates across the grid, develop self-managing software to automatically update, patch and repair the software that manages grid and support a hierarchy of grids that can be geographically distributed. Second, it will develop multi-tenancy mechanisms to securely house multiple customers on a grid thus making this a viable solution for managing and economically providing desktops as a service from a cloud. Finally, additional work to support multiple hypervisors and remote protocols will be developed to address market requirements for cost-effective virtualization technologies and to provide good user experience when deploying the solution across a cloud. This takes advantage of a sizable and growing demand for virtual desktops that offer lower management costs and superior data security. Existing solutions on the market are 4 to 10 times the cost of regular PCs and require highly skilled personnel to operate, thus hampering their adoption. Kaviza's approach, if successful, reduces that costs drastically and makes it possible for the desktop IT staff who procure and manage PCs today, to be able to install and deploy proposed solution within their budgets. Kaviza's solution, if successfully deployed, also has the potential for broad economic and environmental impact. First, it can reduce PC power consumption by up to 75% making offices more "green". Second, its lower cost and simpler management will make it possible to broadly deploy computational resources and bridge the digital divide.

KSPLICE, INC.

Phase II Award No.: 1026735

Award Amount: $500,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Enabling Non-disruptive Updates in Order to Improve OS Security

This Small Business Innovation Research (SBIR) Phase II project aims to bring improvements to OS update technology. These improvements would allow system administrators to apply OS patches faster than current practice, which would significantly hinder botnets and other attackers by reducing the window of vulnerability during which systems are running software with known problems. The current state-of-the-art requires that computers reboot to apply kernel updates. Since rebooting is disruptive, many system administrators delay performing security updates. Security would improve if administrators could apply updates immediately, as hot updates, without the need for reboots or disruption. Although programmers have long been capable of making ad hoc modifications to running programs, hot update technology has not seen widespread use because of key technical problems. In particular, constructing hot updates has always required extensive programming effort, which is expensive and risky.

If successful, this project will impact the state-of-the-art of software updates. Most directly, this research has the potential to deliver a change that the IT industry wants - a way to apply security updates without rebooting. More generally, this research aims to improve the field's technical understanding of how to automatically apply traditional source code patches to a running program, such as the kernel. This problem has broad applications in debugging, profiling, instrumentation, and education. This research can lead to the creation of a hot update service, provided to companies on a per-machine, per-month basis, for a subscription charge. Companies who subscribe machines to this service would, without any ongoing effort, be able to transparently receive hot updates that solve software problems, without reboots or other disruption. This distribution of hot updates would improve security and reliability while decreasing machine maintenance costs. This offering has the potential for wide appeal across the IT industry.

MEDKEN LLC

Phase II Award No.: 1058504

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Mammography Analysis and Reporting System

This Small Business Innovation Research (SBIR) Phase II project seeks to improve medical image analysis and reporting. The project proposes research and innovation on quality of diagnosis, richness of knowledge exchange, privacy and scalability of merging analysis and reporting of medical imaging for the detection of breast cancer. The company proposes a system which allows radiologists to focus on analyzing the image while the system automatically produces a report in the background. The reports are image-based, provide audience-specific levels of detail, and are backwards compatible to text-based reports. The SBIR Phase I project established the efficiency improvements that the proposed system can provide. In Phase II, this project will investigate cloud computing as a model for operating and delivering the company's mammography integrated analysis and reporting software. Cloud computing has proven to be a scalable and cost-effective means of delivering software services to customers and will thus be an important capability of health-care IT providers. However, the image storage and security requirements for medical images will necessitate improvements over existing cloud solution architecture. The Phase II project will develop new methods for delivering richer image-based reports and robust security via the cloud.

Breast cancer affects nearly one in eight women, at a substantial economic and societal cost. Mammography screening is the most effective way to detect breast cancer in its earliest and most treatable phases. However, there are many inefficiencies and quality problems in screening mammograms. While a shortness of radiologists specializing in mammography is driving up costs, there are significant false-negative rate and false-positive rates in screening mammography. This situation creates a clear opportunity for innovations that can provide increased efficiency while maintaining or improving quality. Changes in health-care legislation are yielding incentives for health-care facilities to transition to all-electronic systems. As they do so, many health-care facilities are embracing cloud-based delivery and Software-as-a-Service models. If successful, the Phase II project will continue with research and innovation for the delivery of an integrated analysis and reporting software that will improve the quality of medical image diagnosis while decreasing costs.

Mersive Technologies, LLC

Phase II Award No.: 0750202
Phase IIB Award No.: 1027350

Award Amount: $999,995.00

Start Date: March 1, 2008
End Date: April 30, 2011

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Sector: IT Applications

SBIR Phase II: The Media Fusion Project: A Distributed Architecture for Mega-Pixel Displays

This Small Business Innovation Research (SBIR) Phase II project will develop and deliver a software media architecture that removes a critical barrier to the widespread use of multi-projector, high-resolution, ultra definition displays. The approach defines a set of layered abstractions from the low-level display driver to higher-level protocols including multi-user display use and security. This model is the bedrock of a new display architecture that will not constrain future display innovations, allow content developers and producers to communicate to current and future display systems, and acts to isolate the underlying complexities of new display technologies from users. Building on this new architecture, the Phase II project will implement a software-based Display Operating System. The project is motivated by the perception that we will soon live in a world where displays cease to be individual discreet devices but rather become an extension of our environment; a limitless fabric of pixels.

The potential impact of this innovation is significant, by removing the usability and cost barriers normally associated with ultrahigh-resolution displays, applications once available to only a select few can become commonplace. This has the potential to change the advanced visualization, media interaction models, as well as the way in which we interact with our computational environments.

MetaFlows Inc

Phase II Award No.: 0923846

Award Amount: $500,000.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: IT Applications

SBIR Phase II: Global Correlation Service for Network Security Applications

This Small Business Innovation Research (SBIR) Phase II project is directed toward fulfilling the need of business and Government organizations to more effectively monitor and protect their electronic networks. Network security devices (NSDs) such as Anti-virus, Intrusion Detection/Prevention, spam/phishing filtering, and bandwidth anomaly detection systems have become an integral part of our networks as they provide invaluable services in maintaining data integrity and confidentiality, while protecting the availability of computing resources. This research aims at significantly increasing the timeliness, accuracy and cost-effectiveness of NSDs in combating fast-changing and ever-more sophisticated network security attacks. The programming and maintenance of NSDs is today a very significant obstacle to their wider adoption. The most common and significant complaints of existing NSDs users are (1) excessive amounts of false positive events (events that should not be generated) and the difficulty in analyzing security events (2) their extreme sensitivity to the timeliness of the security updates to catch emerging threats and (3) the expertise required in the installation, maintenance and operation of these systems. These obstacles limit adoption by many smaller companies that cannot afford to hire expert system administrators and network security analysts. MetaFlows seeks to capitalize on these deficiencies by providing ways to outsource this complexity. If successful, this research effort will inexpensively and thoroughly improve the manageability, accuracy and return on investment of many existing NSDs.

MISERWARE, INC.

Phase II Award No.: 1026899

Award Amount: $354,377.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Intelligent Software Power Management for Windows-based Systems

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize an intelligent software power management data center solution. The current default power management can seriously degrade server performance as much as 40% under certain loads. As a result, the default power management is currently not deployed and most servers in the data center are wasting significant energy. The proposed product encourages users to enable the unique power management capabilities to save up to 35% energy under normal load. The approach allows users to set the expected service-level and bound the impact of power management on server performance. For example, users can set a policy of < 10% performance loss and the software will save as much energy as possible without violating the policy. Data center operators require energy efficient servers in the data center. Data centers in the U.S. and abroad provide the technological backbone for the Internet and e-commerce. As of 2005, data centers accounted for 2% of total U.S. energy consumption. Data center managers cite power consumption as their largest concern today since: 1) energy costs to run servers are now typically greater than acquisition costs; and 2) excessive energy use produces heat that reduces system reliability. If successfully deployed, the proposed approach has the potential to address an emerging market pain point and to make a significant positive economic impact.

MobiLaps

Phase II Award No.: 0924704

Award Amount: $538,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: IT Applications

SBIR Phase II: An Emergency Notification System for Delivering Geo-Targeted Information-Rich Web Alerts

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will extend the successful findings of Phase I of the project to investigate the technical feasibility of an innovative emergency notification system that delivers emergency alerts to people over the web. The proposed activity involves advancing technical knowledge in the areas of network edge applications and HTTP traffic processing. With the web having a large audience and increasingly becoming a source of multimedia infotainment, its appeal as an emergency notification channel, in the same vein as TV and radio, has grown, especially given its potential for delivering detailed and customized information. The objective of the proposed research is to complete a network edge application that introduces web alerts to web-users, without requiring any special client-side software installation or web-user registration. The effort will extend the work performed in Phase I to technically mature two key system components: 1) a network appliance component hosting a network edge application that applies innovative HTTP processing algorithms to web traffic to introduce the alert in a controlled fashion and without unnecessarily disrupting the web-user's browsing; and 2) a centralized control component.

The product from the proposed effort will have the potential of enhancing the emergency notification capability and effectiveness at campuses, which in turn bolsters emergency preparedness and response efforts, potentially saving lives during life-threatening emergencies. The long-term plan is to extend the deployment of the product to the general public, thus extending the emergency-related societal benefit to the general public.

Network Foundation Technologies

Phase II Award No.: 0750136
Phase IIB Award No.: 0961261

Award Amount: $1,028,000.00

Start Date: February 15, 2008
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: Implementation, Testing and Refinement of a Hybrid Distributed / Traditional System for Broadcasting Live and Pre-Recorded Content to Large Online Audiences

This Small Business Innovation Research (SBIR) Phase II project has two technical goals. In Year 1 the focus is on increasing the video quality (bit rate) of NFT delivered broadcasts, while keeping bandwidth costs low. In Year 2 the focus shifts to expanding product support to Mac and other non-Windows systems. Network Foundation Technologies (NFT) has developed a patented distributed broadcast technology that overcomes many of the current bottlenecks. The key difference between the NFT approach and the traditional approach is that with NFT the computers and Internet connections of the viewers watching a broadcast help deliver that broadcast on to other viewers. Network Foundation Technologies' products and technology have the potential to significantly impact the way television-style broadcasting is conducted over the Internet, greatly increasing the number of voices that can be heard. While NFT's near term goal is "to bring television to the Internet", the long term goal is to give ordinary citizens their own "online television stations."

Power Tagging Technologies, Inc.

Phase II Award No.: 1058573

Award Amount: $500,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Power Tagging Grid Intelligence for 21st Century Energy Applications

This Small Business Innovation Research (SBIR) Phase II project develops devices and systems to conduct two-way data communication using the electrical power distribution grid as the communications medium. The Phase I research provided information needed to optimize the devices, systems, and methods used, but also raised additional questions that need to be researched during Phase II. This effort includes the development of specialized high-order modulation techniques, filters and shields to allow the equipment to operate in a high-voltage environment, and specialized low-overhead communication protocols to accommodate the constraints imposed by the communications medium. If successful, an application platform for grid applications and a management model for distributed communications and intelligence will be developed. Typically, these needs are being addressed by overlaying a digital network of some sort over the power distribution network. Smart Grid initiatives in development today are complicated by the fact that no one digital communication technology is adapted to all the places and environments in which the Smart Grid must operate. The grid itself is always present wherever Smart Grid intelligence is needed, making on-grid communications potentially the simplest and most cost-effective medium for enabling Smart Grid communications.

Power Tagging Technology encourages a fundamentally different approach to Smart Grid implementation. Early efforts at using technology for demand management by engaging consumers have favored consumers at the high end of the economic scale, ones who live in newer subdivisions, and have the funds, skills, and interest to invest in personal energy management technology. Rural and inner city consumers benefit much less if at all from these programs. However, Power Tagging Technology has the potential to benefit all types of consumers equally through applications like high-resolution Conservation Voltage Regulation that reduces energy consumption and costs for wide-range of consumers. Power Tagging Technology is not only a communications mechanism, but it is inherently also a mechanism for monitoring the grid and inferring information about the electrical distribution infrastructure that is not readily available today. If successfully deployed, Power Tagging Technology has the potential for enabling whole new fields of research and development in Power Engineering and Grid Security.

Prevail Health Solutions LLC

Phase II Award No.: 0956637

Award Amount: $516,000.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: IT Applications

SBIR Phase II: Internet-based Software for the Treatment of Depression among Veterans

This Small Business Innovation Research (SBIR) Phase II research project seeks to determine the feasibility and effectiveness of a Web-based software that provides depression treatment for Veterans returning from Iraq and Afghanistan. A recent Pentagon study concluded that returning Iraqi and Afghanistan veterans are currently suffering from "daunting and growing mental health problems" with nearly 1/3 of these military personnel reporting symptoms of mental illness upon their return from combat. A lack of adequate available resources combined with a fear of stigmatization inherent in seeking face-to-face treatment, prevent as many as 77% of these military personnel from ever getting the treatment they need. The proposed innovation will enable the military's mental health professionals to offer an effective, evidence-based and drug-free depression intervention which will effectively mitigate stigma concerns faced by military personnel and will provide treatment at a fraction of the cost of the typical depression interventions available today.

The key innovation in this proposed research has the potential to create significant value by 1) allowing VA mental health professionals to provide an easily-accessible, evidence-based and drug-free depression treatment to returning military personnel suffering from depression 2) enabling veterans to seek treatment without having to face the fear of stigmatization inherent in seeking face-to-face treatment within the confines of a mental health care facility 3) reducing the economic burden on the military health care system by providing an effective and scalable depression treatment at a fraction the cost of today's typical depression interventions. With an estimated 5 million veterans and 20 million civilians in the U.S.A suffering from depression, cost-effective and innovative methods to help address this burgeoning healthcare problem are critical. Through further research, this Web-based framework has the potential to extend to many mental health problems that plague our country such as PTSD, Drug Abuse, Anxiety and Alcoholism.

QUANTIFIND INC.

Phase II Award No.: 1026493

Award Amount: $400,112.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Units-based numeric data extraction with knowledge of scientific context

This Small Business Innovation Research (SBIR) Phase II project aims to establish that a units-based approach to retrieving quantitative data from scientific and technical documents is a powerful alternative to keyword and document based search models. Keyword approaches to data extraction and contextualization are limited due to poor semantic contextualization and because quantities are often written in a wide variety of numeric and unit formats. The proposed approach to reliable numeric data extraction begins with quantity-intelligent indexing that recognizes many numeric formats and converts quantities to standardized base-unit tokens, to significantly enhance search recall over keyword approaches. The resulting number-unit pairs will anchor the index to enable efficient scientific exploratory search with high semantic precision, but without overly relying on sophisticated imposed semantic ontologies. Research will focus on a proprietary search-time data scoring algorithm that utilizes context-sensitive numeric spectra, to score otherwise ambiguous results based on probabilistic methods. This approach is expected to improve both precision and recall of contextual numeric data extraction. In turn, the resulting search engine will enable instant visualization and analysis of collective technology landscapes and trends, which will guide researchers in any area of technology represented by the indexed documents.

The broader impact of this project will be to enable reliable and efficient extraction of numeric data from diverse sources such as scientific literature and patent databases. These unstructured document sets contain a wealth of latent quantitative data which, if properly extracted and aggregated, can enable powerful modes of data exploration. The unit-based index and data-scoring algorithm are customized for an exploratory search model that will allow non-expert users to rapidly aggregate thousands of relevant data points, with simple keyword inputs and without laboriously opening and parsing individual documents. Researchers and students may thus explore data sets that were previously inaccessible, or known only to experts in a field. This will also contribute to knowledge discovery within large unstructured databases, since patterns and correlations between seemingly disparate variables can be immediately visualized. The platform will provide the capability to efficiently generate technology landscapes, anticipate emerging trends, and recognize competitive technical outliers. If successful, this will be valuable for high-tech industrial innovation including for engineers involved in R&D as well as business development executives and intellectual asset managers who focus on asset allocation, new technology ventures, prior art and patent infringement within a technical parameter space.

RES Group, Inc.

Phase II Award No.: 0822975
Phase IIB Award No.: 1045298

Award Amount: $740,757.00

Start Date: July 1, 2008
End Date: June 30, 2011

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Sector: IT Applications

SBIR Phase II: OpenBio Workbench for Sharing of Mathematical Models in Drug Discovery

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative software platform called OpenBio Workbench that will enable researchers in drug discovery to easily access and share mathematical models and model results. Modeling is becoming increasing important, motivated by the FDA's drive to modernize the drug discovery process and the advent of emerging fields such as Systems Biology. A broad adoption of modeling has been limited, however, because the current practice requires programming and computational skills not typically possessed by experimental researchers in biological sciences. In the Phase II project, the tool's capabilities will be augmented by allowing users to calibrate models by including experimental data, adding innovative advanced modeling tools such as model building.

The potential commercial value of this workbench is high as the pharmaceutical industry is investing significantly in mathematical modeling and Systems Biology aiming to overcome both the high costs of drug development and the stagnation in the discovery of new drugs since the 1990's. Further, aging populations in developed countries are going to cause sharp increases in health care costs, while at the same time there are serious budgetary pressures (both from government and private insurers) to keep health care costs under control. Thus, methods that speed up the research cycle and reduce development costs for new drugs and treatments are going to become increasingly important.

Scientific Media

Phase II Award No.: 0848600
Phase IIB Award No.: 1120098

Award Amount: $532,000.00

Start Date: February 15, 2009
End Date: April 30, 2011

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Sector: IT Applications

SBIR Phase II: The Scientific Media Concise Message Routing System

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and build a method and system for integrating sophisticated advertising capabilities into the Scientific Media Concise Message Routing System. The technology allows anyone with an internet domain name (individuals, small businesses, large corporations, or other organizations) to quickly, easily, and cheaply distribute information via a variety of mobile media, with particular emphasis on text messaging, or SMS. The technology comprises hardware and software that route text-message requests and responses between "subscribers" who access information and "content publishers" who distribute information.

This project seeks to create the system and methods needed to append highly-targeted advertisements to the content requested from publishers by subscribers. Scientific Media believes that the system establishes the framework of an important new method of distributing information via SMS that can be applied in a variety of settings, including consumer, education, and research settings.

SecureRF Corporation

Phase II Award No.: 0924363

Award Amount: $600,000.00

Start Date: August 15, 2009
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: Security Solutions for UHF passive Radio Frequency Identification (RFID) tags

This Small Business Innovation Research (SBIR) Phase II project will develop and prototype passive UHF RFID tags implemented with strong public key cryptography for the pharmaceutical industry. Implementing cryptography directly on passive tags is a significant innovation as current security solutions cannot address this need effectively. The FDA is urging the United States pharmaceutical industry to adopt RFID technology to assist with the enforcement of pedigree laws and reduce drug counterfeiting. Today's RFID tags, however, cannot protect the user from unauthorized reading, copying, or tracking because they lack onboard security. Thus, a large exposure remains since the security of the data on the tag cannot be ensured. SecureRF is developing a security protocol which holds the promise of beings thousands of times smaller and faster than any other cryptographic function. Secured tags will enable drug manufacturers and distributors to ensure patient safety and drug integrity as well as improve their supply chain process.

This SBIR project targets the pharmaceutical industry supply chain which handles over 4 billion U.S. prescriptions annually. Pharmaceuticals must be protected from counterfeiting and theft which impacts public safety and drives up consumer drug prices. Without onboard security, the FDA's recommended use of RFID tags could inadvertently introduce new societal threats including patient privacy concerns under HIPAA. The use of secure RFID tags will also enable the pharmaceutical industry to run their supply chain more efficiently. Additional commercial value from this project will come from developing secure products for high value asset tracking and contact-less payment systems in addition to military and Homeland Security needs. Existing cryptographic algorithms cannot provide strong authentication and data protection on resource-constrained computing devices like passive RFID tags. This SBIR proposal offers a breakthrough with broad-based significance that will help advance the technological understanding of public key cryptography for small, low powered computing devices.

Sensor Analytics Inc.

Phase II Award No.: 0956911

Award Amount: $500,000.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Sector: IT Applications

SBIR Phase II: Real-time Economic Sampling System

This Small Business Innovation Research (SBIR) Phase II project will create a first Real-time Economic Sampling (RES) system for quality intensive high-tech manufacturing. Focusing initially on semiconductor manufacturing, the system will allow defect inspection sampling to be optimized and adjusted many times per day across all process tools, steps, and products. This minimizes, among other things, a manufacturer's economic risk of producing bad products by adaptively focusing sampling where it gives the greatest return. The complexity of the underlying interdisciplinary models have hindered the realization of RES. Recent advancements by the applicants showed feasibility that this research will build on. There are three main research categories, 1) Risk & Optimization, 2) Cycle-Time, and 3) Yield Modeling. Categories 1 & 2 build on Phase I feasibility results where fast, yet accurate, approximations of complex factory models were established. Risk & Optimization modeling will introduce near-term risk due to factory floor events into traditional (long-run average) risk models. Cycle-time research will refine the approximations for queues with heterogeneous servers. Yield modeling will introduce novel real-time yield approximations needed for RES. The included implementation tasks will then create the first factory-ready RES system that captures the necessary intricacies of semiconductor manufacturing.

The proposed RES system is a "Green Manufacturing" enabler that creates a new market as it will be the first to recoup inefficiencies present in many process control operations. The initial focus is on semiconductor manufacturers who are limited by time-consuming off-line analysis, rigid sampling rules, and risky ad-hoc sampling adjustments. Meanwhile valuable products are being wasted due to out-of-control incidents and/or under-utilized inspection capacity. The proposed system can change this. An RES system belongs to a fast growing segment of the semiconductor industry: process control. Other markets can also be pursued and a societal impact due to reduced waste can become widespread.

SFM Technology, Inc.

Phase II Award No.: 0924039

Award Amount: $516,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: IT Applications

SBIR Phase II: Domain-Unified Modeling for Electro-Mechanical Component Libraries

This Small Business Innovation Research Phase II project proposes a framework to support product development, analysis, and decision making in multi-domain engineering environments through domain-unified product models. Ad hoc and even formal (standards-based) product data models, subject to the need for multiple views and attributes to support domain-specific application requirements, suffer from data redundancy and consistency problems. These problems are exacerbated by the implicit nature of information in geometric representation schemes and the difficulty and latency of its access. The intellectual merit of the work lies in the ability of the developed formalism to support the simultaneous generation and maintenance of multiple views of product model data, and the enforcement of consistency between them. A framework is proposed to manage the complexity of model synchronization and view-generation with the domain-unified modeling environment through the active management of constraints and goals for model population and transformation. The framework is to be validated within the context of an environment for the creation, management, and distribution of domain-unified models of packaged electronic components.

The broader impact of this work accrues from the application of the domain-unified modeling methodology to packaged components for printed electronic assemblies (PCAs). The design of electronic products is realized through a combination of electronic design automation (EDA) software tools and computer-aided design (CAD) tools that support a wide variety of inter-related design and analysis disciplines spanning the electronic and mechanical domains (e.g. functional, layout, thermal, manufacturability). These tools are critically dependent on the availability of accurate computer-interpretable models of packaged electronic components. Due to the absence of accepted modeling standards, a lack of effective tools for the creation, maintenance, and distribution of component data, and a lack of interoperability across EDA and CAD tools. The proposed domain-unified modeling tools and data services will enable OEMs to more efficiently mange and distribute component information within their enterprises, OEMs and designers to leverage collective efforts in component modeling, and provide efficient mechanisms for the communication of data between component suppliers and OEMs.

SIFTEO INC.

Phase II Award No.: 1026699

Award Amount: $425,886.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Siftables - Distributed, Gestural Human Computer Interaction

This Small Business Innovation Research (SBIR) Phase II project aims to accelerate commercialization of a new human-computer interface (HCI) platform: Siftables. These are small, wireless, gesture-sensitive displays that act together as one interface. People can efficiently execute cognitive tasks through manipulation of groups of physical objects. These abilities find little purchase in both keyboard/mouse User Interfaces (UIs) and newer UIs with single displays.

The proposed platform provides a UI that can address a broad range of human-computer tasks, from media creation to data analysis to social communication. Historically, the entertainment domain has provided a profitable staging area in which to introduce novel UI systems - this market is large, has price flexibility, and its consumers have a demonstrated desire for novel interactions. This domain will provide a path to profitability, familiarize consumers with multi-object interfaces and allow the Siftables technology time to mature before other market opportunities are pursued. If successful, this system will allow the company to advance the state of the art of distributed operating systems and sensor networks.

SKRIBEL, INC.

Phase II Award No.: 0958266

Award Amount: $500,000.00

Start Date: March 1, 2010
End Date: February 29, 2012

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Sector: IT Applications

SBIR Phase II: Knowledge Discovery based on Personal Web Content Annotation

This Small Business Innovation Research (SBIR) Phase II project aims to develop a Recommendation System that offers users links to relevant pages as they browse the Web. As users interact with a Web page annotation platform, they use tools, such as highlighters and sticky notes, to annotate pages. The System is able to leverage these annotations to accurately model the user's information need, and to deliver high-quality recommendations. This Phase II project builds upon a prototype developed in Phase I, applying techniques from the information retrieval and natural language processing research communities to improve recommendation quality. This project encompasses primary research in document modeling, index representations and retrieval models. Further, the project proposes interesting synergies by drawing in methods from the text categorization, topic detection and tracking and collaborative filtering communities.

The Broader Impact of this work lies in its potential to positively impact the task of doing research on the web. The company's nascent Web annotation Platform promises to save users time, reducing cost and frustration by providing content management and organizational structures that allow them to preserve state between web research sessions. The next step is to deploy the Recommendation System to bring users the next page they need before they even realize they need it. Individual users and businesses alike will derive value from the time savings provided by the company's Platform and its Recommendation System.

Stone Ridge Technology

Phase II Award No.: 1058544

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Bioinformatic FPGA Appliance

This Small Business Innovation Research (SBIR) Phase II project will build an FPGA based Bio-informatic appliance for processing DNA sequence data faster, at lower cost and with less power. Over the last decade the cost of sequencing a genome has dropped by six orders of magnitude and the throughput of the process has increased by five orders of magnitude. The trend shows no sign of abating and industry experts expect the $1,000 genome mark to be reached in the next year. The combination of lower prices and higher throughput has lead to what is being called "the data deluge" or the "the data tsunami". Taming this deluge has become a major issue in Bio-informatics and a principle bottleneck to further advances. The objective of this Phase II project is to contribute a solution to the processing problem based on Field Programmable Gate Arrays (FPGAs), non-conventional computing platforms that operate at significantly higher efficiency measured in cost and power per performance unit.

The mechanism of genetic coding, identified by Watson and Crick in 1953, was one of the premier scientific advances of the twentieth century. It took twenty more years to identify a feasible approach to decipher the genetic code of a particular individual and twenty more to actually implement it. The first human genome was sequenced in 2003. By 2010 less than 1,000 humans have been sequenced but rapidly decreasing costs and increasing throughput promise that the number will increase exponentially and medical researchers foresee the day in the near future when the whole population will be sequenced as part of standard medical practice. The advances that will be enabled by partial or full sequencing of the population will bring a revolution to health care ushering in an era of personal genetic based medicine. If successfully deployed, the proposed approach has the potential to address the so-called data deluge and bring about significant savings in both processing time and power consumption.

Team Patent LLC

Phase II Award No.: 1057933

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Patent End-To-End (PE2E) Examination

This Small Business Innovation Research (SBIR) is directed to developing Patent End-To-End (PE2E) application examination capabilities that utilize cloud-enabled software services to enable the United States Patent and Trademark Office (USPTO) to collaboratively examine patent applications with enhanced validation, search, and office action support, resulting in higher quality and lower pendency. PE2E objectives include support for formalities review, search planning, annotation/collaboration, and office action formulation. The outcome of this investigation would potentially shift the way in which intellectual property is examined; providing examiners with tools to more deeply understand patent applications, collaboratively research prior art, and more easily document their assessments of the application prior art.

The U.S. economy relies heavily and increasingly upon intellectual property, and patents are one currency of this economy. As patents become more significant in the operations and outcome of U.S. businesses, it becomes increasingly important to assure that the patent examination system delivers high quality and timely examinations in order to support the next-generation of innovations. If successfully-deployed the proposed innovation has the potential to make a significant positive impact upon the US patent and trademark landscape.

The Echo Nest Corporation

Phase II Award No.: 0750544
Phase IIB Award No.: 0944324

Award Amount: $1,000,000.00

Start Date: April 1, 2008
End Date: March 31, 2012

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Sector: IT Applications

SBIR Phase II: Automated Community and Sentiment Mining for Global Media Preference Understanding

This Small Business Innovation Research (SBIR) Phase II project applies data mining and machine learning techniques to both natural language description and Internet link graphs to model communities in order to predict preference, taste and sentiment for different kinds of media (music, TV, online media, video games, books). Current contextual information mining approaches that scan the text on a page for advertisement or recommendation ignore valuable community connections inherent in most self-published Internet discussion. Sentiment and opinion extraction systems operating on full text create challenging language parsing problems are fraught with issues of scale and adaptability. The identification systems can automatically categorize anonymous Internet writers or website visitors into specific demographic communities based on their tastes in many kinds of media. The Phase II research project approaches opinion extraction with a bias-free learning model based on training from known online corpuses that can be adapted to different languages and learns in real time as more data becomes available for high accuracy.

Current personalization and marketing approaches either look at the "clickstream" of an anonymous user, leading to equally anonymous recommendations for popular movies and music -- or by scanning a surface-level overview of the text, leading to keyword advertisements with limited contextual understanding of entertainment content and community sentiment. The project plans to fully integrate people-focused community and sentiment analysis technologies into an autonomous, learning and scale-free "media knowledge service" for digital entertainment providers and marketers that can change the way digital content is marketed and sold.

Thousand Eyes

Phase II Award No.: 1058602

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: An Integrated Solution for Global Visibility and Security of Internet Services

This Small Business Innovation Research (SBIR) Phase-II project will develop a software-as-a-service product that provides actionable network intelligence to online businesses, enabling them to quickly identify and troubleshoot problems that affect their end users. Studies have shown that a poor end-user experience results in a tangible loss of revenue. Yet, online businesses are dependent not only on their own infrastructure, but on the state of the rest of the Internet as well. From the end user perspective, problems with the network infrastructure, third-party content provider issues, or traffic redirection attacks can result in sites being unavailable or slow. Hence, outside-to-inside monitoring of online services is critical for any Internet business if they wish to remain competitive. Unfortunately, existing products often treat the Internet as a black box. They are unable to capture where things have gone wrong or what could be improved inside the network. In this Phase-II proposal, the company takes a bottom-up approach to capturing end-user experience by focusing on understanding and measuring the components of the Internet infrastructure (such as DNS) that are responsible for data delivery. If this effort is successful, businesses will be able to ensure that their service is globally available, proactively identify performance bottlenecks at the network level, and be alerted immediately when under a traffic redirection attack.

Businesses that operate on the Internet expect data from monitoring services to be actionable. While some products provide actionable information regarding problem components in web pages, The company offers actionable insight into the network infrastructure that drives content delivery to end users. The impact of this technology is two-fold. First, the technology enables customers to improve content delivery to their end users, which leads to increased revenues. Second, the technology can protect businesses from falling prey to traffic redirection attacks, protecting both themselves and their users from financial losses due to fraud. If successfully deployed, the proposed innovation will address an emerging and significant pain point for online merchants and service providers alike.

TOKUTEK, INC.

Phase II Award No.: 1058565

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: A Multithreaded Storage Engine using Highly-Concurrent Fractal Trees

This Small Business Innovation Research (SBIR) Phase II project will apply multithreading techniques to provide multi-terabyte (and larger) high-performance databases in MySQL. The company has developed a highperformance storage engine for MySQL, which maintains indexes on live data 100 times faster than current commonly-used structures. The technology solves the problem of maintaining indexes on large databases in the face of high trickle-load indexing rates. In Phase I, the company developed a multithreaded bulk loader to solve the problem of how to load data quickly. The next significant research problems for large MySQL databases are to allow online, or "hot", schema changes in which, for example, an index can be added without taking the database down, and to use multithreading to speed up joins and reductions so that the large data sets can be queried quickly In this project, the researchers will investigate the use of multithreading to support hot indexing and parallel joins reductions.

If successful, multi-terabyte and larger databases will be manageable and fast on modest hardware, and the hardware will be scalable both with CPU cores and disks. The broader impact of this work is driven by faster, cheaper, lower-power on-disk storage. Organizations that have very large databases will be able to use much less hardware, both saving money and reducing power consumption significantly. Currently many application areas do not employ databases because their performance is too slow. Speeding up databases by two orders-of-magnitude can help grow the market. Currently, many organizations fail to make good use of the data they have collected because they cannot manage it, index it, or query it fast enough to be useful. Applications in finance, retail, homeland security, telecommunications, and scientific computing will benefit from improved manageability and performance. As users' appetite for data continues to outstrip the availability of fast memory, organizing multithreaded queries on disk-based data for performance will continue to grow in importance.

TXTEAGLE INC

Phase II Award No.: 1026853

Award Amount: $500,000.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Large-Scale Analysis System for Mobile Crowdsourcing

This Small Business Innovation Research (SBIR) Phase II project seeks to create a new, innovative system to manage a highly-scalable, geographically-distributed labor force through wireless technology - what is refered to as " mobile crowdsourcing." The plunging cost of handsets and the introduction of prepaid call plans have allowed individuals throughout the world to have the ability to communicate and transact electronically. This project will create the infrastructure needed to provide wireless subscribers the ability to do work and earn money - leveraging today's mobile phone's ability to send, receive and display images, audio files and text. The system will: deconstruct a client's work into "micro-tasks;" preferentially route micro-tasks to individuals most likely able to complete them; statistically analyze completed work across individual responses to automatically reach a decision on when work is complete, and who has provided the most useful input; compensate workers in proportion to the value they have added; and, finally, reconstruct the completed task for the client, with a statistical assurance the work has been accomplished correctly.

The first application of this system will be for the business process outsourcing (BPO) industry. The company will integrate with several mobile carriers in Africa and South America to allow subscribers direct access to transactional BPO tasks including transcription, translation and text categorization. Communicating with workers directly through phones and emphasizing quality control on work, rather than worker will enable users to perform tasks when they want, where they want, and as they want. Automated compensation through existing mobile payment and airtime transfer systems will allow for much lower overhead costs. In addition to cost savings, however, clients who use this system to complete work will also have the benefits of: increased security (no one worker will be able to see an entire document or hear an entire audio recording), access to a scalable workforce (when "spikes" of work come through, labor can be seamlessly scaled up), and potential for very fast turnaround on work (micro-tasks can be done in parallel by many individuals, greatly reducing total time to complete a workload). Additional applications of the mobile crowdsourcing platform include data gathering related to local content and surveys, productivity tools for auditors, and mass reporting abilities following disaster-related events.

Veros Systems, Inc.

Phase II Award No.: 0923919

Award Amount: $515,984.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: IT Applications

SBIR Phase II: Adaptive Methods for Sensorless Estimation of Induction Motor Efficiency

This Small Business Innovation research (SBIR) Phase II project will develop and field-test a system for obtaining accurate on-line, in-service estimates of energy efficiency of industrial electric motors. The effort will further exploit the basic technology at the core of the condition monitoring & assessment (CM&A) product being developed by Veros Systems. Inc., and will become a key feature of that product. This monitoring technology is sensorless, in that only electrical measurements, i.e. voltages and currents available at the motor control centers, are utilized. No information from mechanical sensors, such as speed, torque, vibration or temperature, is necessary. Consequently, this reliable and effective CM&A technology is cost-effective and cost-scalable. The proposed approach to efficiency estimation is based on employing the raw electrical measurements that are collected for use by the existing CM&A product framework, and augmenting them with adaptive filters for accurate estimation. The Phase II research plan calls for the refinement of the online, in-service efficiency estimation algorithms defined in the previous Phase I effort.

The broader impacts of the project include awareness of the importance of energy efficiency in industrial motors, which account for about 25% of all electricity sold in the U.S. Widespread adoption of this energy conversion efficiency estimation technology could reduce the total energy consumption by industrial motors up to an estimated 18%. These energy conversion efficiency costs, together with the costs of maintaining electric motors and the costs of lost production associated with motor downtime are among the most significant controllable costs of industrial establishments. Even a modest adoption of more effective CM&A and efficiency estimation technologies would eliminate some fraction of this waste and have a significant impact on the U.S. economy, while enabling clients to reduce their energy costs, increase profitability, reduce fuel imports and lower greenhouse emissions.

Video Semantics LLC

Phase II Award No.: 1058428

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: IT Applications

SBIR Phase II: Multimodal Semantic Video Retrieval and Summarization

This Small Business Innovation Research (SBIR) Phase II project will develop contextual video segmentation and automatic tagging technology and software. In long video streams that contain one or more topics, the software automatically discovers the beginnings and ends of Contextually-Coherent Video Segments in each video. Moreover, Video Semantics' technology automatically assigns textual tags to each segment such that these tags describe the topic discussed in that segment. The tags assigned make all parts of the video easily searchable. Large video producers currently depend on manually segmenting their content into small segments and assigning textual tags to these segments in order to make them searchable. A short advertisement is then inserted before each segment. This manual segmentation and tagging process represents a significant pain point for content producers because it is labor intensive and not cost effective. Meanwhile, government agencies, which continuously monitor video content depend on speech recognition to spot specified keywords. This approach inflicts two pain points: (i) analysts have to deal with large number of false detections because the context in which the keyword occurs might be irrelevant, and (ii) if the keyword occurs in an important context, analysts still need to scroll back and forth into the video to find the beginning of the relevant segment.

Video Semantics' technology and products have the potential to efficiently address significant market needs. In addition to the commercial applications, the proposed technology will enable media monitoring agencies to perform their tasks more efficiently saving valuable analyst time and resources. Moreover, because Video Semantics' technology is language-independent, media monitoring agencies will be able to monitor more content in foreign languages without the need to develop language-specific technologies. The company will employ an indirect sales strategy via partnerships with software companies that develop media monitoring solutions and metadata generation tools. The company has identified its first customer and is working with them to integrate the contextual segmentation and tagging technology with their current media monitoring solutions.

VUELOGIC LLC

Phase II Award No.: 0923704

Award Amount: $508,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: IT Applications

SBIR Phase II: Predicting Behavior in Electronic Commerce Environments

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project involves the examination of consumer consumption behavior across multiple on-line domains to predict those items to be most likely consumed in the next interchange and the terms under which they will be consumed. The proposed innovation utilizes a persistent key technology to examine multiple attributes of identity to establish a unified identity that links individuals across multiple domains. Once linked the unified identity serves as the basis for the aggregation of consumption behavior (purchases, content, ads clicked through, invitations extended, etc.). The aggregated data establishes the consumer's digital footprint and serves as the basis for creating highly-predictive models. The models analyze the actual consumption behavior to establish consumption propensity and terms of consumption on an industry segment level. The results of the propensity models will be returned to the client at the time of interaction to make up sell / cross sell offers that are most likely to result in action by the consumer. The result for the client is increased revenue for the transaction and the result for the consumer is increased satisfaction through the relevance of the offer.

The broader impact of the proposed innovation involves three aspects: Accelerating economic expansion, identifying potential domestic terror threats and identifying potential on-line predatory activity. The ability for a retail or social network to identify the consumption preferences of their customers and offer those items during an interaction increases the likelihood that a customer will purchase the offered item due to its relevance. Such expansion of customer spending will assist organizations in increasing inventory turnover, improving sales and overall economic health. Identification of potential domestic terror threats through the examination of cross domain purchasing behavior of linked identities. Intelligence Services could establish purchase combinations that when combined could result in a potential treat and take appropriate early intervention action. Identification of potential on-line predators through the use of persistent key technology to highlight those individuals whose established identity on other domains is materially different from a current registration. This permits the organization to establish higher authentication requirements for those individuals and in so doing protecting itself and in the case of Social Media its members (specifically minors).

X5 Systems, Inc.

Phase II Award No.: 1026900

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: A Search Engine for Antenna Design

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and launch a software tool that applies advanced AI algorithms to antenna design and optimization. Manual antenna design and optimization methods are time- and labor-intensive, limit complexity, and require significant expertise. Genetic algorithm (GA) optimization has demonstrated success at quickly finding effective antenna design solutions not ordinarily found through engineering intuition. To harness the power of these search algorithms currently, an engineer must be an expert in both GAs and Electromagnetics. In Phase I, feasibility of a highly-automated design approach where useful antennas can be generated without requiring significant guidance was demonstrated: the user simply inputs design requirements (e.g., RF performance, dimensions, etc.), and an automated optimization produces compliant designs.

If successful, this technology promises to improve the performance and economics of future antenna applications for commercial and government customers. The world is in the midst of an explosion in the number of new wireless, mobile, and RF systems - all of which rely on one or more antennas. Yet antenna design has changed little in the past two decades, with large up-front costs and slow, inefficient trial-and-error methods. X5 Systems is attempting to bring to market a next generation way to design antennas: one that is faster, better, cheaper. The commercial potential of the proposed software system encompasses application areas of interest to companies in mobile and wireless, RFID, and consumer electronics, as well as government agencies - especially applications that have exacting performance, schedule, and cost requirements.

NANOTECHNOLOGY, ADVANCED MATERIALS & MANUACTURING

ADVANCED MATERIALS

MANUFACTURING TECHNOLOGIES

NANOTECHNOLOGY

3F, LLC

Phase II Award No.: 0956907

Award Amount: $489,506.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

STTR Phase II: High-Strength Low-Cost Fiber Via Multi-Component Nanofiber (MCN) Spinning

This Small Business Technology Transfer (STTR) Phase II project has the overall objective of developing a multi-component melt spinning approach to produce a new family of high performance fibers using standard low-cost polymers. The new high-strength and/or high-modulus polymeric fiber is to be made using cutting-edge but commercially available spinning technology and an innovative and previously unexplored set of spinning process parameters. The resulting new fiber will be comparable in performance to other high-performance fibers on the market today, but will cost significantly less. Spinning experiments will be conducted at both the laboratory/bench scale, and at the pilot line level. Experimental fiber spinning lines will be modified to enable consistent fiber manufacturing. Produced fibers will be characterized using a variety of tools (focused ion beam, scanning and transmission electron microscopy, X-ray, tensile, lateral compression, density, differential scanning calorimetry, and dynamic mechanical analysis) to understand the new mechanisms that lead to improved strength and/or stiffness. The spinning conditions which enable these mechanisms will be optimized to meet target strength and/or stiffness goals. The possibility of introducing UV-resistant additives and/or other application-specific components, and any corresponding effects on performance, will also be studied.

The broader impact/commercial potential of this project is based on achieving a performance goal for the new fibers of tenacity > 15 gf/denier and/or an initial modulus of 400 gf/denier or greater. Given the anticipated capability for low-cost high-volume production, these new fibers will have a cost approaching that of standard high tenacity industrial fibers (~ $7/lb) as compared to the typical >$20/lb for specialty high performance fibers such as aramids and high-performance polyethylene (HPPE). The new fiber products will be designed to have a performance above current high-tenacity industrial fibers (HT polyester and nylon) but below current specialty high-performance fibers (aramids, HPPE). The reduced cost for these fibers will result in lower costs over a variety of applications, which will benefit society (for example, by the greater proliferation of cut-resistant apparel and other safety/protective devices). In addition to these economic benefits, the proposed work will provide extensive characterization of nano-scale fibers that will contribute to the scientific understanding of polymeric fiber structure and behavior.

Advanced Cooling Technologies, Inc.

Phase II Award No.: 0956865

Award Amount: $451,156.00

Start Date: February 1, 2010
End Date: January 31, 2012

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Sector: Advanced Materials

STTR Phase II: Condensation on Gradient Surfaces

This Small Business Technology Transfer (STTR) Phase II project proposes innovative heat transfer research involving dropwise condensation on a wettability gradient. Dropwise condensation alone has shown the ability to increase condensation heat transfer coefficients by an order of magnitude over film condensation, typical of vertical thermosyphons. Droplets condensing on a gradient surface experience different contact angles, causing the droplets to accelerate to high velocities in the direction of increased wettability. The difference in contact angle on opposite sides of the condensing droplets is due to locally varying properties of the condensing surface, controlled by varying surface concentrations of molecules with low surface energy. The higher droplet velocities caused by condensing on the gradient surface further increases the heat transfer coefficient over typical dropwise condensation. Furthermore, the gradient surface does not require gravity to remove liquid from the condensing surface, enabling dropwise condensation heat transfer on horizontal surfaces and in microgravity applications. In this proposal, the technology demonstrated in Phase I will be integrated into a vapor chamber heat transfer device suitable for electronics cooling.

The broader impact/commercial potential of this project will be felt in the thermal management industry. Specifically, incorporating this innovation will enable significantly improved thermal performance in vapor chambers, leading to cost savings and allowing improved performance in a number of industries. In the computing industry, solutions for notebook computers and servers are becoming increasingly limited by thermal issues. In micro-gravity environments, these new gradient surfaces will replace or enhance the capillary forces currently used in heat pipe devices, such as axially grooved heat pipes and loop heat pipes, for communication satellite applications. In the nuclear industry, more efficient condensation directly increases electrical conversion efficiency. There is already a demand for higher capacity thermal solutions, and this demand will only increase as commercial entities and government agencies expand their capabilities and demand greater thermal dissipation. This development effort will also enhance the fundamental understanding of liquid movements due to surface gradients and similar Marangoni flows, which will have an impact in various fields, including research related to fluid pumping in micro-fluidic applications.

Advanced Diamond Technologies

Phase II Award No.: 1058505

Award Amount: $463,694.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Low-cost Long-life Diamond Electrodes for Wastewater Treatment using Advanced Electrochemical Oxidation

This SBIR Phase II project will employ the boron-doped ultrananocyrstalline diamond (BD-UNCD) electrodes developed during the Phase I project to fabricate and characterize electrochemical cells and systems for the on-site generation (OSG) of advanced oxidants (chlorine-based mixed oxidants - hydrogen peroxide combined with hypochlorite - and sodium persulfate) and apply them to targeted water treatment applications. The primary research objectives are to determine the optimal conditions to generate oxidants and to establish the projected lifetime of the electrodes. BD-UNCD cells will demonstrate higher rates of oxidant production at lower costs and with greater energy efficiency than competing electrodes due to higher current densities and over-potentials for O2 and H2 evolution at the anode and cathode. The known difficulties with existing approaches of disinfection, such as the inadequate destruction of pathogens (Cryptosporidium), ineffective operation below 10°C, generation of large quantities of O2 and H2, and electrode fouling are expected to be mitigated substantially through use of BD-UNCD electrodes. Sodium persulfate (SPS) has been used as a highly effective oxidant capable of oxidative destruction of recalcitrant organics such as in oil-contaminated sea water. BD-UNCD technology will dramatically reduce the cost and increase flexibility of OSG water treatment using SPS.

The commercial potential of this project is the development of a safer, cheaper, more environmentally friendly technology to generate "green" oxidants using diamond electrodes that can be used for a number of water treatment applications including purification, disinfection, and remediation. The market for chlorine-based disinfection systems alone is $20 billion with a correspondingly large impact on human health and national security issues associated with transporting vast quantities of hazardous materials. Overcoming technical barriers that have prevented diamond from being used for oxidant generation will require advances in the synthesis and large-scale manufacturing of diamond thin films that will impact other applications of this material. The electrochemistry of diamond is not well understood in the conditions needed for OSG. Better understanding of these reactions and the technological trade-offs between cell design and electrode geometry will impact related applications including the development of compact systems for third-world potable water generation, small scale desalination, the energy efficient electrochemical synthesis of new materials and other point-of-use applications of advanced oxidants.

Advanced Photonic Crystals, LLC

Phase II Award No.: 1058055

Award Amount: $499,873.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Hydrothermal Growth of Potassium Beryllium Fluoroborate (KBBF) for deep UV Nonlinear Optical Applications.

This Small Business Innovation Research (SBIR) Phase II project will develop a commercial growth process for single crystals of KBe2BO3F2 (KBBF) using hydrothermal techniques. The compound was developed 10 years ago and shows exceptional promise as a deep UV non-linear optical (NLO) material. The sub-200 nm region is presently inaccessible for solid-state lasers, and optical components functioning at these wavelengths are limited. KBBF has excellent deep UV properties and shows great promise for laser applications like frequency doubling and wavelength mixing. A previous flux growth method for the crystals demonstrated excellent performance in deep UV lasing, but the material is very difficult to grow in the required single crystal form. Additionally, China has embargoed crystals grown by this method, as well as the process, so KBBF crystals are currently unavailable outside of China.

The broader impact/commercial potential of this project will be to continue to develop the hydrothermal method for growth of single crystals for optical applications. NLO materials are vital for the development of solid-state lasers with wavelengths below 200 nm for use in photolithography, micromachining and spectroscopy. The availability of KBBF crystals will also enable new technologies, such as standoff explosive detection. This technology will help the rebirth of the advanced materials industry in the United States. The crystal growth industry has moved nearly completely offshore, leaving the United States vulnerable in terms of advanced applications, with a shrinking pipeline of new strategic materials, especially in the field of optics. This field is particularly dependent on new materials and the US is in serious danger of losing our once-substantial competitive edge. Additionally, a postdoctoral student will be supported through a subaward to Clemson University, and will become part of the next generation of materials scientists and engineers in this country.

Amethyst Research Incorporated

Phase II Award No.: 0724233
Phase IIB Award No.: 0963599

Award Amount: $830,594.00

Start Date: September 1, 2007
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Photon-Assisted Hydrogenation Process Technology for Manufacturability and Improved Operability of HgCdTe Infrared Detectors

This Small Business Innovation Research (SBIR) Phase II project will deliver an innovative hydrogen passivation technique for improving manufacturability and performance of HgCdTe infrared detectors. Photon-Assisted Hydrogenation (PAH) causes the substrate to be hydrogenated by simultaneous exposure to hydrogen gas and ultra-violet (UV) light which allows hydrogen to diffuse into and become a permanent part of the substrate. In Phase I the feasibility of PAH for the fabrication of high-performance near-infrared HgCdTe avalanche photodiode (APD) arrays on large-area silicon wafers was demonstrated. In Phase II PAH will be optimized for fabrication of HgCdTe infrared sensors from a variety of sources.

The PAH process will not only create a new product line of high-performance HgCdTe/Si-based APDs, but may also provide a means to effect significantly higher yields, and thus lower costs for all manufacturers of HgCdTe-based detectors. PAH technology will enable all HgCdTe infrared device manufacturers to grow on Silicon wafers, significantly reducing the cost of these high value systems, and making them more generally available for a broad range of currently unaffordable applications, including civil transport, aviation, medical and robotic vision systems. Derivatives of the this technique may be applied to the manufacture of a variety of other optoelectronic semiconductor devices requiring passivation to mitigate defects.

Arbor Photonics

Phase II Award No.: 1058538

Award Amount: $444,892.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: High Power Pulsed Fiber Laser for EUV Lithography

This Small Business Innovation Research (SBIR) Phase II project has the core objective to develop a modular, laser power scaling concept based on recent innovations in high efficiency fiber lasers. The proposed concept uses large mode area, chirally-coupled core fiber to construct high power, pulsed fiber laser modules that can be spectrally combined into a single, collinear beam delivering multi-kilowatts of average power. Power scaling of a laser source with characteristics appropriate for the generation of extreme ultraviolet (EUV) radiation is a key obstacle to the technical maturity of EUV lithography. EUV lithography is the leading candidate for high volume manufacturing of the next generation of semiconductor integrated circuits with critical dimensions of 22 nm or less. The Phase II effort builds on the successful Phase I feasibility and design results by developing the critical components and constructing a prototype laser module. Results expected from this work include construction and characterization of key laser components capable of withstanding high laser peak powers and demonstration of a breadboard, prototype fiber laser capable of producing pulse energy of 1 millijoule or more with pulse lengths of 5-30 nanoseconds at pulse repetition rates in the range of 50-200 kHz.

The broader impact/commercial potential of this project is the continued advancement of semiconductor integrated circuit performance. A key metric in this advancement is the minimum critical dimension that can be realized in the manufacture of these devices. Advances in lithography have enabled a decrease of approximately 30% in this dimension every two years, which has led to a doubling every eighteen months in the number of transistors on an integrated circuit. This trend, known as Moore's Law, has fueled an explosion in the processing power, storage capacity, efficiency and affordability of microelectronic devices. EUV lithography, currently under development, is the critical manufacturing technology that is needed to sustain this trend on the five to ten year horizon. Development of a power scalable laser, operating in the nanosecond pulse regime, is a critical element in the practical realization of EUV lithography. Success in this endeavor will help to deliver continued advances in microelectronic devices that benefit fields of study and industry as diverse as genetic engineering, telecommunications, computer engineering and transportation.

Brewer Science Incorporated

Phase II Award No.: 0924563

Award Amount: $515,287.00

Start Date: September 15, 2009
End Date: August 31, 2011

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Program Director: Ben Schrag

Sector: Advanced Materials

STTR Phase II: Flexible and Extended Range Radio Frequency Identification Tags

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project focuses on developing a commercially viable process for producing a versatile passive radio frequency identification (RFID) tag. Existing passive tag technologies have many limitations that hinder their widespread use. The most significant limitations include minimal operating range, high unit costs, and a rigid form that makes the tag difficult to adhere to curved or irregularly shaped surfaces. This project aims to overcome these limitations by utilizing two innovative technologies. The first technology is a new type of field-effect transistor (FET) that is fabricated from high-purity and semiconducting-enriched single-walled carbon nanotube (SWCNT) solutions. These innovative FETs provide improvements in operating frequency and current-carrying capacity which enable an extended RFID range. The second innovation is a high-speed, highly accurate, and ultrafine-dimension-capable system for depositing electrical components and antennas onto flexible substrates at or near room temperature. This project aims to culminate in the production and evaluation of prototype carbon nanotube-based RFID tags that meet the value-added needs of the RFID marketplace.

The broader impact/commercial potential of this project will be the development of low-cost, flexible, and extended-range RFID tags. These tags will provide industry and the U.S. Government with a reliable and economic methodology for managing and tracking supply chain inventory, will allow an expansion in the use of smart cards, and will enable the identifying and tracking of animals and marine life, a critical element in protecting endangered species. The results of the project will also improve applications such as passive radio frequency identification (RFID) tags, flexible electronics, IR-invisible antennas, and embedded IR sensing, imaging, and communications.

Chemat Technology Inc.

Phase II Award No.: 1026215

Award Amount: $499,997.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Thick Piezoelectric Films with Dielectric Constant above 3000

This Small Business Innovation Research (SBIR) Phase II project aims to develop high dielectric constant (high-K) thick film for high-frequency ultrasonic transducer. Thick piezoelectric film technology is very attractive for the fabrication of thin piezoelectric element in high-frequency ultrasonic medical imaging applications. However, it is challenging to process high-quality piezoelectric film with thickness in the range of 10-20 micrometers. In addition, the film needs to demonstrate dielectric constant of 3000 or higher due to the need of electric matching in fabricating array transducers. In previous Phase I project, a piezoelectric thick film with dielectric constant higher than 3000 was demonstrated. In this Phase II project, the high-K thick film will be utilized to develop miniature high frequency single element and linear array transducers for Intravascular Ultrasonic (IVUS) imaging applications.

The broader/commercial impact of this project will be the potential to provide high-K thick film to enable the application of miniature high-frequency ultrasonic transducers. IVUS is a medical imaging methodology using a specially designed catheter with a miniaturized ultrasound probe attached to the distal end of the catheter, which is inserted into the heart or into a coronary vessel for visualizing the vessel and heart structure. This project is expected to further miniaturize the ultrasonic transducer mounted on the catheter and provide improved resolution. With this anticipated catheter, surgeons may view the arteries of patients more clearly and spend less surgery time. Plus, the smaller size will make the procedure less invasive. In addition, this technology can also be used in other applications such as Radio Frequency (RF) filters for cell phone, ultrasonic valve and tuning devices, liquid delivery and droplet ejectors, chemical and biomedical sensors etc.

Claytec Inc.

Phase II Award No.: 0822808
Phase IIB Award No.: 1049511

Award Amount: $830,000.00

Start Date: July 1, 2008
End Date: June 30, 2012

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Sector: Advanced Materials

SBIR Phase II: Automotive Nanocomposites

This Small Business Innovation Research (SBIR) Phase II proposal aims to commercialize a new mesoporous silicate nanoparticles for the reinforcement of thermoplastic polymers used in the manufacture of U.S. cars and light trucks. Whereas nanoparticles, in general, provide some polymer reinforcement benefits, they typically lack the ability to provide strength as well as stiffness. Also, they normally require extensive organic surface modification for dispersion in the polymer matrix. Organic modifiers limit nanoparticles thermal stability and compromise their suitability for nanocomposite manufacturing through cost-effective melt processing methods. The purely inorganic mesoporous silicates this project plans, circumvent all of the limitations caused by organic modifies by providing a unique combination of surface polarity, mesopore size, surface area, and pore volume which optimizes interfacial interactions between the particles and the polymer matrix for effective dispersion and reinforcement. In addition to providing stiffness at particle loadings, the mesoporous silicates provide strength, which allows the amount of polymer needed to produce an automotive part to be reduced in proportion to the added strength. The polymer savings alone allow users of the technology to reduce the weight of the vehicle, achieve stiffness, and improve fuel economy at no added cost.

The broader impact/commercial potential of automotive nanocomposites can directly impact the US energy economy, as well as environmental quality. The combination of reduced vehicle weight and increased fuel economy translates into a reduction in petroleum consumption and green house gas emissions. The process for producing mesoporous silicate nanoparticles is neither energy-intensive nor environmentally harmful. Based on aqueous sol-gel chemistry, this project's nanoparticles are manufactured in yields at a temperature of with no harmful waste released to the environment.

Composite Technology Development, Inc.

Phase II Award No.: 1026873

Award Amount: $464,124.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Novel Fire-Resistant Toughened Benzoxazines

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and demonstrate flame-resistant, polymer-composite materials based on novel benzoxazine resin chemistries. In the Phase I project, low-viscosity benzoxazine resins were synthesized and composite formulations prepared that exhibit suitable processing characteristics for use in composite manufacture, as well as good mechanical strength and flame resistance. These successes were achieved through the development of polymer synthesis techniques, and validated by the subsequent fabrication and testing of continuous fiber-reinforced composites. For example, the Phase I results showed that these new polymer formulations offer significantly reduced processing temperatures, which simplifies composite manufacturing processes and reduces tooling costs. In addition, the fiber-reinforced composites produced using these materials exhibited 15-20% higher tensile strengths and 50% higher toughness values as compared to composites fabricated using the as-synthesized (i.e., not toughened) material. This finding is important and shows that composites with strengths comparable to those of epoxy-based systems, but with superior flame resistance, can be achieved with these new materials.

The broader impact/commercial potential of this project will initially be in the electronics and aerospace markets. Flame-resistant polymers and composites are becoming increasingly important systems in both of these industries. In each case, the use of fire-resistant materials offers enhanced public safety, while also improving the overall performance of the systems in which they are used. The value of high-strength flame-resistant materials is perhaps most evident in the civil aviation industry. In this instance, the transition to composite materials offers a significant weight savings, with reductions in weight accounting for a large percentage of recent improvements in aircraft fuel efficiency, while also enhancing the flame resistance of aircraft structures. In addition, the use of advanced materials is expected to increase steadily in electronics applications over the next 10 years, and the further development and commercialization of benzoxazine resins will provide the users of this technology with enhancements in both fire safety and system-level performance.

Creative Electron, Inc.

Phase II Award No.: 1026864

Award Amount: $499,913.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Lead-Free Sintering Adhesives for Electronics Thermal Management

This Small Business Innovation Research (SBIR) Phase II project will further the development of lead-free transient liquid phase sintering (TLPS) adhesives with very high thermal and electrical conductivity for packaging high-power semiconductor devices. Conductive adhesives are typically used for low-cost assembly, but these materials represent the weakest point in the thermal path. To address this issue, TLPS conductive adhesives form metallurgical bonds with the adherent metallization and can provide an order of magnitude or more improvement in thermal performance versus existing adhesive technologies. These low-cost, lead-free materials are designed as drop-in replacements for existing manufacturing processes. During this Phase II project, the focus will be the formulation, characterization, and qualification of lead-free TLPS adhesives for high-volume semiconductor device manufacturing. The primary objective of this project will be the demonstration of an order of magnitude improvement in effective thermal conductivity compared to commercial conductive adhesives for electronics packaging. Advanced characterization techniques, along with durability studies, will be instrumental for bringing these materials to a readiness level suitable for market penetration.

The broader impact/commercial potential of this project is the development of new semiconductor die-attach materials suitable for the low-cost packaging of high-power semiconductor devices. A number of industries are aggressively developing innovative product lines centered on the concept of energy efficiency and higher performance; these include hybrid electric vehicles (HEVs) in the automotive sector, high-brightness light emitting diodes (HBLEDs) in commercial lighting, and concentrator photovoltaics (CPVs) for utility-scale electricity. Further, next-generation silicon devices, particularly those based on stacked-die architectures, also require improved conductive adhesives to fully enable their performance benefits. At present there exist no RoHS-compliant products that can satisfy all the needs identified by these markets in a cost-effective fashion. Yet these needs are becoming more urgent as a multitude of electronic devices reach the limits of today's heat dissipation technologies. The primary products which will result from this Phase II effort are advanced thermally and electrically conductive adhesives that can meet the thermal management requirements of advanced semiconductor packages while lowering their cost of manufacture.

Ecovative Design LLC

Phase II Award No.: 1058285

Award Amount: $387,637.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Advanced Materials

SBIR Phase II: Method of Disinfecting Precursor Materials using Plant Essential Oils for a new Material Technology

This SBIR Phase II project seeks to further develop, and demonstrate at scale, a biological disinfection process that has exhibited superior microbial inactivation to steam pasteurization at a lower cost. This process leverages dilute concentrations (0.5-0.875% by volume) of plant-derived phenols and aldehydes to inactivate lower level fungi and bacteria found on agricultural byproducts (seed husks and hulls). The application focus for this demonstration is a novel material technology that converts lignocellulosic waste into a high performance, low cost replacement for synthetics (plastics and foams) using a filamentous fungus. This biological disinfection process can reduce process energy consumption by 83% and system capital expense by upwards of 50%. This project will fully quantify the efficacy of this disinfection process at scale (production volumes) as well as analyze the integration of this technique into a mycological material production facility that is presently addressing the protective packaging industry. Batch and continuous systems will be explored, and a comprehensive economic model will be developed based on the results. The mycological materials that are produced under this demonstration will be compared with materials fabricated with the existing pasteurization system, and samples will be evaluated by customers to ensure product adoption.

High-embodied energy disinfection processes, autoclave sterilization or pasteurization, are ubiquitous within industries such as agriculture, food processing, and biotechnology. These methodologies are implemented to reduce or remove background bioburden (bacteria, yeast, mold) that can be detrimental to downstream processes due to contamination. Mycological materials production represents such a process since raw material contamination results in product loss and added labor. The plant essential oil disinfection technique was proven under the Phase I research to offer a comparable process time to steam pasteurization and superior disinfection efficacy; thus this technology could serve as a drop-in replacement in some industrial applications. This process minimizes capital equipment and operations costs due a reduction in system complexity and energy consumption. In regards to the production of mycological products, this disinfection process bolsters the process robustness by extending contaminate inactivation periods which promotes rapid mycelium colonization or a reduction in incubation time. Therefore new market opportunities for mycological materials can be addressed while further supporting the business case for regional manufacturing using domestic agricultural waste as raw materials. Finally, the benefits obtained from this novel disinfection process permit an accelerated deployment and development of turnkey production systems to displace synthetic materials.

Electron Energy Corporation

Phase II Award No.: 1026786

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Synthesis of Hard Magnetic Nanoparticles and Fabrication of Micromagnets for Microelectromechanical System (MEMS) Applications

This Small Business Innovation Research (SBIR) Phase II project aims to develop anisotropic hard magnetic nanoparticles and nanoflakes based on rare-earth transition metal compounds, which can be agglomerated by screen printing and tape casting into micro- or sub-millimeter permanent magnet structures. The excellent magnetic properties, small size and particular morphology of the nanoparticles and nanoflakes will allow for high magnetic performance with dimensions that bridge the current gap between the permanent magnet thin films (about a few microns) and micromachined permanent magnets (typically larger than 500 microns). This project is expected to (1) synthesize permanent magnet nanoflakes and nanoparticles with magnetic properties comparable to those of the bulk counterparts, (2) prepare monolithic isotropic and anisotropic hard magnetic thick films by screen printing, (3) fabricate solitary isotropic and anisotropic hard magnetic thicker films or structures by tape casting, and (4) develop prototypes of sub-millimeter permanent magnet structures for terahertz (THz) devices and micro-undulators.

The broader/commercial impact of this project will be the potential to provide stable permanent magnet particles with submicron dimensions in large amount and with close-to-bulk magnetic properties, which will be an enabling technology for the $3.9 billion magnetic MEMS (Microelectromechanical Systems) market. The applications include micro-sensors, -motors, -generators, -undulators, high frequency (THz) vacuum electronic devices etc. The permanent magnet nanoflakes can also be used in anisotropic bonded magnets, which have many industrial applications with a market size of $434 million per year worldwide.

Everspin Technologies

Phase II Award No.: 1058552

Award Amount: $499,347.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Structures for reduced critical current to enable Spin Torque MRAM

This Small Business Innovation Research (SBIR) Phase II project aims to demonstrate a high-performance spin torque magnetoresistive random access memory (ST-MRAM). ST-MRAM technology promises a powerful combination of non-volatility, high density, high speed, and low power. The major impediment to commercializing ST-MRAM has been that the write current for programming the magnetic tunnel junction (MTJ) bits are too large. Large write current can cause tunnel barrier breakdown, thereby compromising memory reliability. Additionally, large write current requires large select transistors beneath each bit, preventing high density. In Phase I project, an MTJ bit design with a low enough write current has been successfully demonstrated. In this Phase II project, a large, high-density ST-MRAM demonstration circuit will be developed using this improved bit design. Several novel circuit design approaches that have potential for higher speed, higher density and lower power will be evaluated. The circuit will provide the bit statistics needed to optimize the bit design and enhance the yield to the level required for a highly reliable commercial ST-MRAM.

The broader/commercial impacts of this project will be the potential to enable the commercial applications of ST-MRAM. The Toggle MRAM is already finding many applications in the stand-alone memory market including networking, industrial controls, data server systems, military, aerospace industry etc. However, in order for MRAM to achieve its full commercial potential, higher density and lower power consumption are needed. High density translates to lower cost. Reducing power consumption is increasingly valued in areas such as portable electronics or even enterprise computing. ST-MRAM technology has the potential to meet these needs by combining non-volatility, high density, high speed, low power, unlimited endurance, and scalability in a single memory.

Fusion Coolant Systems, Inc.

Phase II Award No.: 1058288

Award Amount: $404,463.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: Minimum Quantity Lubrication Delivered by Supercritical Carbon Dioxide for Forming Applications

This Small Business Innovation Research (SBIR) Phase II project aims to develop next-generation supercritical CO2 metalworking fluid (MWF) technology for highly demanding metal forming applications. The approach is to deliver specialized environmentally-friendly lubricants with supercritical CO2, achieving tool wear rates, forces, and surface finish at least as good as aqueous-based MWFs that are currently in use. It is anticipated that a much smaller amount of MWFs will be required with this technology. The formulation of new supercritical MWFs and the optimization of flowrates of oil and CO2 for metalworking processes will be studied. The patented supercritical CO2 system (so-called CHiP Lube) will be evaluated in real industrial settings to confirm its capability to replace current MWFs. The effectiveness and efficacy of CHiP Lube system will also be scaled and applied to other common industrial metal working processes such as rolling, extruding, and cutting.

The broader/commercial impacts of this project will be the potential to provide an environmentally-benign lubricant system as an alternative to conventional MWFs with equal or better performance and lower cost. At any given time, approximately 2 billion gallons of MWFs are in use in the U.S.A. This represents a massive waste stream that must be treated and remediated. Plus, the negative effects of MWFs on worker health and safety are well documented. The components of CHiP Lube are naturally occurring and used in extremely low quantities. Therefore, the waste treatment and worker health concerns are minimized. CHiP Lube has been demonstrated in simple metal removal applications as providing lower tool wear and/or higher machining speeds than conventional MWFs, thereby leading to a lower overall cost of manufacturing. In addition, no carbon dioxide will be produced to run the process, as the CO2 used in the process will be recovered from other industrial processes such as ammonia and ethanol production.

Grandis, Inc

Phase II Award No.: 0924041

Award Amount: $499,904.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Dual Magnetic Tunnel Junction (DMTJ) Materials and Structures for STT-RAM

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovative Research (SBIR) Phase II project will address material innovations required to successfully take spin-transfer torque (STT) switching phenomenon from a research environment to commercialization. The goal of this Phase II project is to deliver Dual Magnetic Tunnel Junction (DMTJ) technology at three progressively smaller technology nodes, and to develop a package of data on DMTJ devices, including materials structure, read and write performance, and reliability characteristics, that can be transferred to licensees for commercialization.

The outcome of this project will be STT based Random Access memory (STT-RAM), a fast, high density, low power, nonvolatile universal memory solution that has the potential to displace mainstream semiconductor memories such as Static RAM, Dynamic RAM and Flash in both embedded and standalone memory markets, and create entirely new sectors in the semiconductor industry. Not only can STT-RAM replace each of these memories individually, but from a system perspective, STT-RAM offers the potential to revolutionize electronic system architectures in a way that can significantly reduce power, component count, area and cost, while dramatically improving system functionality and performance.

Integrated Surface Technologies

Phase II Award No.: 1026571

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Durable Super-Hydrophobic Nano-Composites

This Small Business Innovation Research (SBIR) Phase II project seeks to further develop and commercialize a new class of durable, water-resistant nanocomposite coatings identified and explored during the Phase I project. The unique processing conditions used to make these nanocomposite coatings produce a virtually invisible, conformal, nanometer-scale film that is comprised of surface bound nanoparticles and offers superior water barrier properties while still permitting through-film electrical connections. The newly developed coating has the potential for great commercial impact and can be thought of as a "game changer" for certain consumer electronic markets. The innovation and research plan for Phase II centers on two critical issues for commercial integration: 1) the overall processing efficiency of the material and 2) issues of long-term reliability and chemical interaction with existing platforms.

The broader impact/commercial potential of this project will be felt in a number of consumer, military, and medical products. It is estimated that about 1.2 billion mobile handsets are produced annually and that 8% of all the damages that occur to handsets are from liquid ingress. If fully adopted by the industry, this coating could reduce the liquid ingress damage to nearly zero, resulting in significant savings to consumers. Additionally, medical hearing aids would benefit from the oleophobic protection provided by this material, and its use would result in a decrease in the number of units returned annually for corrosion, water damage and ear wax contamination (this number currently stands at 11 million). Finally, the integration of our protective coating into other existing electronics products will add significant value to these products and will make them more durable and attractive to consumers globally.

InterPhases Solar, Inc.

Phase II Award No.: 0823118
Phase IIB Award No.: 1110422

Award Amount: $682,021.00

Start Date: December 15, 2008
End Date: November 30, 2011

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Sector: Advanced Materials

SBIR Phase II: Spray Deposited Transparent Conducting Zinc Oxide Films

This Small Business Innovation Research (SBIR) Phase II project seeks to develop a cost-effective, non-vacuum technology to deposit p-type transparent conducting oxide (TCO) films. The lack of effective p-type TCOs has been a long-standing problem for the electro-optic industry. It is the crucial component to advance photovoltaic technology with n-type absorbers. The Phase I project developed cutting-edge spray pyrolysis technology to deposit wide-gap p-zinc oxide (p-ZnO) films. The project achieved important breakthroughs, both in terms of the new deposition system, as well as achieving p-ZnO films with inexpensive spray pyrolysis. The structural and electro-optical data for the ZnO films validate the feasibility of the new deposition approach and provide a compelling measure of project success. The Phase II project will advance the deposition system, improve the scientific understanding of doping issues, derive process-property correlations to optimize the electro-optical properties, and integrate technology into existing technology.

The broader impact/commercial potential for new optoelectronic products is increasing exponentially, owing to the demand for clean energy and the microelectronics revolution. The deposition method offers cost and manufacturability advantages over current vacuum methods; it is remarkably versatile to deposit a number of other technological semiconductors that are amenable to spray deposition. The p-ZnO films can be used for short-wavelength light-emitting diodes, laser diodes, energy efficient windows, flat panel displays, gas sensors and other opto-electronic applications. It can extend photovoltaic technology to n-type absorbers and multi-junction flexible solar cells for higher efficiency. The commercialization of this technology will provide energy security, avert future power crises and reduce global warming.

IONOGRAPHICS, INCORPORATED

Phase II Award No.: 0923856

Award Amount: $508,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Advanced Materials

SBIR Phase II: Manufacturing of Package Test Socket Contactors through Innovations in Electrochemical Printing

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project addresses the low volume manufacturing of test probe cards through Electrochemical Printing. Integrated Circuit Board Testing Connectors(ICBTCs) include contactors that are metal structures designed to contact integrated circuit boards (ICBs) at the wafer level during production with wafer probe cards (WPCs) or after packaging with package testing sockets (PTSs). WPC contactors are manufactured with semiconductor processes (SPs) in high volume whereas PTS contactors are built in lower volume with conventional microfabrication (CM) or low cost plating through dryfilm masks on flexible substrates. There is increasing pressure to reduce the ICB package size and PTS contactor dimensions while also reducing testing costs. This project addresses these needs by developing a moderate cost, high resolution electrochemical printing technology.

The broader impacts of this research include providing repair solutions for high value products that are currently thrown away and reducing plating bath inventory in an electrodeposition tool by at least 10X. The long term opportunity is for EcP is to revolutionize desktop microfabrication because it is a low cost, single step process that has promise of producing complex 3D fully functional polymer, semi-conductor, and metal parts.

KENT OPTRONICS, INC.

Phase II Award No.: 1058571

Award Amount: $441,558.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Ultrafast Self-Reactive Laser Eye Protection Devices

This Small Business Innovation Research (SBIR) Phase II project will develop ultra-fast laser eye protection (LEP) devices from nano-composite materials. Commercial LEP eyewear can only protect against a limited number of known laser wavelengths, with users having to change eyewear for different lasers. The new LEP eyewear will be a universal solution to protect human eyes against both known and unknown lasers in the visible and infrared (IR) spectral range, promising >60% visual luminous transmittance, >4 optical density, femtosecond response time, and full compliance with industrial and military standards. The LEP eyewear is expected to have adequate optical limiting threshold so that it does not require an extra focusing lens array for assistance. The material to be developed is semi-solid and can be integrated with ballistic-proof polycarbonate (PC) substrates, and requires no electrical power. This project will also be applicable to products for laser protection of optical sensors. The Phase II research activities involve material and manufacturing process optimizations as well as environment durability tests.

The broader impact/commercial potential of this project is significant. It will meet the critical unmet customer demand for a universal laser eye protection device, which is key in many military and industrial fields. The LEP products will create cost savings for customers (by providing a universal solution), reduce eye injury risk, and allow ballistic and shatter-proof capability. These devices have the potential to address the entire laser eye protection market, and cumulative LEP eyewear sales for the first five years are projected to exceed $10 million. This program will also advance the state-of-the-art in science and engineering, in developing novel nanostructures from phase-transitioning materials, as well as a new device structure with superior optical characteristics. Finally, this project will have societal benefit by helping to reduce the medical, insurance and associated costs of laser eye injuries.

Lake Shore Cryotronics, Inc

Phase II Award No.: 0924659

Award Amount: $499,521.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Sector: Advanced Materials

SBIR Phase II: Epitaxial Metal Oxide Thin Films Using a Novel Polymer Assisted Deposition (PAD) Technique

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II proposal seeks to develop extremely high energy density capacitors based on spin-on metal oxide dielectric and conductor technology and will combine this technology with very high surface area substrates fabrication technology. This capacitor technology will be all solid state, inexpensive to produce, and will rival ultracapacitors in energy density. The frequency range and loss characteristics will be superior to those of other capacitor technologies and will be polarity independent. The dielectrics will be adaptable through the range of properties of the perovskite family of metal oxides, as well as non-perovskites, and will be useful for multilayer, metamaterial tailoring of properties to fit the requirements of various applications, including high voltages.

The broader impact/commercial potential from this technology will be availability of high reliability, high performance capacitors for critical applications at a reasonable price due to lower cost of manufacturing. It is a disruptive technology that has applications in other areas such as solar cells, ferroelectric memories, sensors, and micro-actuators. This technology will be part of the solution for alternative energy sources and will help improve the nation's chances for energy independence.

LC Vision, LLC

Phase II Award No.: 1058604

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Ion and Radical-Free, Polymer-Stabilized, Vertically-Aligned Nematic LCDs for Enhanced Lifetime

This Small Business Innovation Research (SBIR) Phase II project will develop a new type of process to improve the quality and reduce the cost of large liquid crystal displays (LCDs), particularly those used for energy efficient high-definition televisions. Rather than the existing approaches that synthesize a polymer inside the display, this research examines polymers synthesized and purified outside of the display. Side-group liquid crystal polymers (SGLCPs) will be developed that can be used at low concentration as dopants in the liquid crystal mixture that is the active medium in the LCD. Chemical variations on the successful SGLCPs discovered in Phase I will establish molecular-level understanding of the mechanism of the beneficial effects of the dopant. Effects of the dopants on processing behavior (e.g., the process of filling the flat panel) and ultimate performance will be characterized; the results will guide industrial implementation of the dopants.

The broader impact/commercial potential of this project on new polymer dopants include improved performance of LCD-TVs, especially in the rapidly growing HDTV segment. Liquid crystal displays are widely used in televisions due to their low operating voltage, low power consumption and thin form factor. Polymer additives will be developed that increase the switching speed, enhance the brightness, improve the viewing angle and maintain the excellent dark state and high contrast that are the hallmarks of vertically-aligned nematic liquid crystal displays (VAN-LCDs). The potential revenues of these compounds could reach $100 million annually within a few years. Scientifically, polymer dopants in LCs represent an entirely new field of science and technology. Finally, this collaborative research will involve a combination of microsynthesis, polymer and LC physical properties and LC display fabrication that will confer upon its principals a comprehensive perspective on the transition of discoveries into competitive product offerings.

M V SYSTEMS, INC

Phase II Award No.: 0925131

Award Amount: $411,414.00

Start Date: October 1, 2009
End Date: September 30, 2011

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Sector: Advanced Materials

SBIR Phase II: Fabrication of Low-bandgap Nano-crystalline SiGeC Thin Films Using the Plasma Enhanced Chemical Vapor Deposition (PECVD) Technique

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This SBIR Phase II project is to develop thin film tandem solar cells, comprising of nanocrystalline silicon and silicon carbon (nc-Si and nc-Si:C) absorber materials, with a conversion efficiency of ~20%. The phase I project successfully developed one of the key components, i.e. intrinsic nc-Si:C with a band gap, Eg, of ~ 1.5 eV and with good opto-electronic properties. This key material will be used initially in phase II to fabricate cells in a single junction configuration with an efficiency goal of ~10%. Previously, developed "device quality" nc-Si materials, with Eg ~1.1eV, were used to produce solar cells with efficiency ~8%. Integrating the two devices in a tandem junction configuration is forecast to yield efficiencies of ~18%. Further improvement in the tandem junction device efficiency,to ~20%, may be achieved via the use of buffer layers at the p/i or i/n interfaces and by increasing the grain size which would boost the open circuit voltage, Voc. Higher efficiency thin film tandem solar cells will be critical to achieving the low costs necessary to achieve widespread adoption of photovoltaic energy generating systems.

NBE TECHNOLOGIES, LLC

Phase II Award No.: 0923894

Award Amount: $499,982.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Advanced Materials

STTR Phase II: Nanoscale Silver Pastes for Low-Temperature Joining of Power Semiconductor Devices

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project aims to accelerate the commercialization of an enabling nanomaterial for joining semiconductor chips. The unique features of this innovative material would reduce the manufacturing cost for making lead-free electronics that are required to work in harsh environments and to possess significantly improved performance and reliability over the state-of-the-art technologies. This project focuses on obtaining and sharing extensive scientific knowledge that will lower the risk and barrier for electronic manufacturers worldwide to rapidly implement this nanomaterial in mass production.

The broader impacts of a successful project will be to electronics manufacturers in the United States. The U.S. has fallen behind their European and Asian competitors in the move to lead-free products. This enabling nanomaterial will reduce manufacturing complexity and cost, and will help U.S. manufacturers in capturing a significant share of nearly $500 million-dollar market for chip-attach materials.

NITEK INCORPORATED

Phase II Award No.: 0924013

Award Amount: $493,733.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Sector: Advanced Materials

SBIR Phase II: Bulk AlN Growth For III-Nitride Devices

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will result in the development of a novel semiconductor growth technique to produce low dislocation density III-nitride AlInGaN substrate materials for high efficiency deep UVLEDs and electronic devices. This novel growth technique termed Metalorganic Hydride Vapor Phase Epitaxy (MOHVPE) is a hybrid of Metalorganic Chemical Vapor Deposition (MOCVD), used for device growth where atomic layer accuracy is required, and Hydride Vapor Phase Epitaxy (HVPE), used for fast bulk growth. Their combination in a single growth reactor allows for the growth of very thick, low dislocation density films as substrates templates. Then the growth mode can be switched to the metalorganic sources to grow atomically controlled device active layers, such as quantum wells, without taking the wafer out of the growth chamber.

The MOHVPE AlGaN substrate technology will lead to higher efficiency Power Electronics and deep UV LEDs. Deep UV LEDs offer the potential to greatly increase our understanding of the interaction between UV light and biological/microbiological species. This is increasingly important as we confront the global trends of an aging population (healthcare), increased population density leading to greater pathogen exposure and water shortages, and greater cross-border travel. Researchers are just beginning to investigate applications for UV radiation including cancer treatment, increased plant/food yield, and genetic modification with an increasing interest based on the ability to more controllably deliver UV radiation to particular points of interest that has been enabled by UV LEDs.

NuForm Materials, LLC

Phase II Award No.: 0923822

Award Amount: $607,251.00

Start Date: July 15, 2009
End Date: December 31, 2011

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Sector: Advanced Materials

SBIR Phase II: Improved Manufacturing Methodology for Aluminum Ash Metal Matrix Composite Materials

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5).
This Small Business Innovation Research(SBIR)Phase II project seeks to overcome the principal impediments of the inconsistent quality of metal matrix composite (MMC) materials from fly ash and aluminum. This project utilizes highly processed ash derived ceramics (ADC) as a reinforcing phase in aluminum MMCs manufactured with powder metallurgy (P/M) methods. The processed ADC has a narrow size distribution and is free of carbon, magnetite, and cenospheres. In powder metal technology the ADC alters the strength, stiffness, and hardness of the aluminum. When blended with aluminum powders and compacted into parts, aluminum MMC materials can be fabricated with stiffness properties like ductile iron. Sintering parameters can be manipulated to control the aluminum-ADC reaction and the silicon metal and spinel that it generates, thus creating wear resistance and hardness. The MMC then behaves like a hypereutectic alloy. The primary objective of this project is to formulate one or more high performance ADC-aluminum MMCs that are ready for commercial deployment. Achieving this level of performance will allow ADC-aluminum MMCs to compete directly with hypereutectic alloys and ductile iron in the production of parts for the transportation industry.

The broader impact/commercial potential of this project will be the ability to derive high quality, ash derived ceramics (ADC) that are recovered from coal combustion ash for use in new light weight high strength composite materials. These materials are needed in the transportation industry where weight, cost, and performance are critical. ADC-aluminum metal matrix composites can be used to manufacture parts for the transportation industry such as brake rotors, and drive train components that are currently made from ductile iron or hypereutectic alloys, materials that are heavier and/or difficult to machine. This material change will decrease the overall weight of the vehicle, thereby improving its fuel efficiency and performance while improving the margins for parts manufacturers. This technology will create a new commodity that will lead to the creation of new jobs and help support the needs of the automotive and transportation industries.

Orthogonal, Inc

Phase II Award No.: 1058509

Award Amount: $467,701.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Enabling large-scale manufacturing of organic electronic devices using photolithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a photoresist system that is compatible with a much wider range of materials than traditional photoresists, allowing for the patterning of advanced semiconducting polymers and small molecules on existing photolithographic equipment. Through Phase I project, Orthogonal has improved its fluorinated photoresist system by making two new materials with lower manufacturing cost and enhanced performance. In this Phase II project, the patterning of the widely used conductive polymer poly(3,4-ethylene dioxythiophene):poly(styrene sulfonic acid) (PEDOT:PSS) and similar acidic materials will be studied. Multiple approaches will be taken to continuously improve the performance of the new photoresist materials. The scalability of one or both photoresist materials to large quantities will be investigated by addressing the major issues that may be challenging to the scale-up, including dealing with heat generation and finding a suitable initiator.

The broader/commercial impacts of this project will be the potential to enable the large-scale manufacturing of organic electronic devices by leveraging the existing photolithographic infrastructure currently used in the industry. The availability of the new photoresist materials in large quantities and consistent quality will help meet the performance and volume demands of organic electronic industry, which is expected to grow rapidly once a scalable and high-yield manufacturing technique is available.

Performance Polymer Solutions Inc.

Phase II Award No.: 0750177
Phase IIB Award No.: 1118511

Award Amount: $901,678.00

Start Date: January 1, 2008
End Date: December 31, 2011

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Sector: Advanced Materials

SBIR Phase II: Innovative Isotropic Ultra-High Thermal Conductivity Diamond Composite Materials

The Small Business Innovation Research (SBIR) Phase II project will further develop and demonstrate an innovative class of composite ultra-high thermal conductivity materials for solid state electronics thermal management applications. There exists a growing need for high thermal conductivity materials that exhibit greatly increased isotropic thermal conductivity and lower density compared to existing thermal conductivity materials and composites. Materials with these characteristics do not presently exist, but are enabling for many other future applications. Under the Phase II effort, the P2SI Team will develop these materials and characterize the fundamental structure-property-processing relationships to enable manufacturing scale-up and commercialization.

The P2SI concept is for an "Engineered Material" where the processing behavior and the resulting macroscopic performance (thermal conductivity) is a unique function of the composite architecture. Building the proposed ultra-high isotropic thermal conductivity materials from a multi-scale constituent level represents a leap in technology that was first developed from the fundamental level and validated in the Phase I program. The impacts of this research are twofold: providing a foundation for a new technology in materials science research; and utilizing these fundamental findings to develop and engineer enabling materials to meet growing needs in industry for thermal management applications.

PolarOnyx Inc.

Phase II Award No.: 0952237

Award Amount: $499,705.00

Start Date: April 1, 2010
End Date: March 31, 2012

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Sector: Advanced Materials

SBIR Phase II: A MHz High Energy Femtosecond Fiber Laser System for High Throughput Photonic Device Fabrication

This Small Business Innovation Research (SBIR) Phase II project will develop an integrated femtosecond high-energy fiber source for high-throughput photonics device fabrication. The final goal of the project will be a laser oscillator/amplifier that confines the pulse to the fiber throughout the generation and amplification process. This will lead to high stability, robustness, and easy integration into other systems. These characteristics will make the fiber laser system superior in terms of production throughput, size, and cost. Phase II will develop a functional prototype of the fiber laser. To demonstrate the ability of the laser to fabricate real-world devices, experiments will be carried out involving the microfabrication of glass and waveguide channels.

The broader impact/commercial potential of this project will be a breakthrough in understanding of high-energy femtosecond fiber lasers and an unprecedented new design for laser products across a wide range of applications. The new laser product will offer a combination of high power, high repetition rate, and low cost which surpasses any existing laser on the market today. Potential markets include photonic device fabrication (e.g. for waveguides, couplers, modulators, and switches), metal processing (welding, cutting, annealing, and drilling), semiconductor and microelectronics manufacturing, general materials processing (e.g. rapid prototyping, desktop manufacturing, micromachining, and photofinishing), medical equipment, and biomedical instrumentation. In the medical area, potential applications include ophthalmology, refractive and general surgery, photocoagulation, therapeutics, imaging, and cosmetic applications. Biomedical measurements which might be affected include cytometry, DNA sequencing, laser Raman spectroscopy, spectrofluorimetry, ablation, and laser based microscopes.

PORIFERA INC.

Phase II Award No.: 1058572

Award Amount: $499,710.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Ultra Permeable Carbon Nanotube Membranes for Forward Osmosis

This Small Business Innovation Research (SBIR) Phase II project will take advantage of the unique properties of carbon-nanotube (CNT) pores to develop membranes that are specifically tailored for forward osmosis (FO) applications. FO processes have a number of advantages over evaporation and pressure-driven membrane processes: low energy cost, low mechanical stresses, and high product concentration. The main problem impeding the widespread use of FO remains the lack of robust optimized FO membranes. CNT membranes are ideal for FO applications as they offer improvements in all relevant membrane characteristics: (1) improved structural integrity; (2) high permeability; (3) robust chemical stability; and (4) low fouling propensity. Most importantly, CNT membranes can be fabricated with sufficient structural support in the active layer to operate with only minimal external reinforcement, which minimizes concentration polarization losses. This project builds on the fabrication and functionalization approaches developed in Phase I, and applies them on a larger scale to achieve the objective of developing membranes with fast flow and high selectivity at reasonable production costs. Performance of the membranes will be benchmarked using laboratory tests that simulate real-world applications. This project will deliver an innovative FO membrane platform that exhibits superior performance and stability in FO applications.

The broader impact/commercial potential of this project will be to enable a variety of green technologies such as renewable power generation, wastewater reuse, and energy-efficient desalination. Although FO-based processes are extremely energy efficient, their commercial use has been hampered by the lack of high performance FO membranes. This project should produce two main outcomes. First, it would deliver a solid technical foundation for developing a novel FO membrane platform that would provide a superior commercial alternative to existing FO membrane architectures. Second, the performance advantages of the CNT membranes would open up several applications for commercial development.

Romny Scientific, Inc.

Phase II Award No.: 0848530
Phase IIB Award No.: 1123386

Award Amount: $1,014,926.00

Start Date: March 1, 2009
End Date: May 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Thermo-Electric Conversion by Optimally Scaled Nanocomposite Materials

This Small Business Innovation Research (SBIR) Phase II project will develop a power generation device capable of converting waste heat into electricity with much lower cost/watt than existing devices. This work is accomplished by bringing together principles of physics and materials science in practical wafer scale semiconductor manufacturing, enabling new, low cost products.

The thermoelectric power generation devices to be developed in this work are key to realizing the often touted but yet unrealized societal benefits of thermoelectric power generation. Examples of benefits that can be forseen in the initial target market, the transportation industry, are economic benefits for the public from reduced fuel consumption and reduced environmental impact due to more efficient operation.

SC Solutions Inc.

Phase II Award No.: 0923830

Award Amount: $580,033.00

Start Date: August 15, 2009
End Date: January 31, 2012

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: Model-Based Control for Chemical-Mechanical Planarization of Copper/low-k Films

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop a commercial prototype of a real-time model-based controller software for next-generation Chemical-Mechanical Planarization(CMP) systems used in semiconductor wafer manufacturing. Planarization is an enabling step for semiconductor interconnects that is critical to the industry's keeping up with Moore's law. Future technology nodes of 32 nm and below require improved level of performance in planarization technology. Smaller dimensions and the use of more delicate low-k films pose increasingly stringent requirements on planarization performance.

The successful development of the proposed controller software will help extend planarization to new levels of performance for 32 nm technology and beyond. The copper planarization market is anticipated to reach $824 million in 2009, and a next-generation CMP controller product will have a significant impact on the future of this market. The proposed innovations will help to accelerate the adoption of new dielectric structures in next-generation semiconductor devices.

Sensor Electronic Technology, Inc.

Phase II Award No.: 0956746

Award Amount: $534,765.00

Start Date: January 15, 2010
End Date: December 31, 2011

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: Deep UV LED with High Quality p-AlInGaN Layers by Digital Doping Control

This Small Business Innovation Research Phase II project will develop and commercialize next-generation high-power deep ultraviolet light emitting diodes (DUV LEDs) with high quality p-type doped AlInGaN layers via migration-enhanced metal-organic chemical vapor deposition (MEMOCVD). DUV LEDs operating in the spectral region from 240 nm to 365 nm are of great importance for medical, bio-analytical, sensing, and homeland security technologies. This project aims to improve the LED efficiency and lifetime by improvements in the material quality, doping, and device design. These enhancements will lay the groundwork for large-scale penetration of high volume markets, such as global sanitation and disinfection. This Phase II project will achieve efficient multiple pass extraction in transparent epitaxial structures through use of high-quality MEMOCVD doped p-AlInGaN top contact layers. Achieving an improved quality of highly doped p-AlInGaN layers will allow creation of a low-cost, high power semiconductor DUV radiation source with wall plug efficiency exceeding 5% and operation lifetimes longer than 5,000 hours.

The broader impact/commercial potential of this project will originate from the market penetration of DUV LEDs into existing markets that require compact and environmentally friendly UV radiation sources. This project will also allow penetration into new applications that were previously unattainable due to the inherent limitations of existing UV lamps or lasers. The primary markets for these devices include bio-medical and analytical instrumentation, fluorescence sensing, ink curing, phototherapy and water/air disinfection. This new technology for manufacturing high-efficiency and long-lifetime DUV devices will allow these semiconductor light sources to have a price point which is competitive with the mature UV lamp technology. This will allow the increased use of an environmentally friendly, mercury-free UV technology for a variety of applications, which will result in a reduction of toxic waste and in the costs associated with mercury lamp disposal. The purification, sterilization, and early warning applications enabled by these new DUV LED sources will also result in an improved quality of life, particularly in the developing world.

Soraa, Inc., aka SJS Technologies

Phase II Award No.: 1026896

Award Amount: $499,999.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: High quality, low cost bulk gallium nitride substrates

This Small Business Innovation Research (SBIR) Phase II project aims to develop a scalable, compact and rapid ammonothermal method to grow high-quality, low-cost bulk gallium nitride (GaN) substrates. A novel apparatus that is scalable to large volumes at modest cost will be utilized to achieve high-pressure, high-temperature conditions and grow single-crystal GaN. This project is expected to demonstrate the synthesis of ultrapure raw material and the growth of high-quality bulk GaN crystals with excellent crystallinity, improved transparency, a diameter of at least 1 inch and a process capable of rapid scale-up to larger sizes.

The broader/commercial impact of this project will be the potential to offer high-quality and significantly lower cost GaN substrates, which may enable their applications in next generation displays including light-emitting diodes (LEDs), green and blue laser diodes etc. Bulk GaN substrates, currently in use for 405 nm laser diodes only and grown by a vapor-phase technique, are projected to be a $405 million market in 2010. The availability of low-cost and high-quality bulk GaN substrates is anticipated to improve efficiency and reduce cost of GaN-based LEDs, which will enable a large reduction in electrical power consumption.

Spectrum Scientific, Inc.

Phase II Award No.: 0924702

Award Amount: $515,611.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

STTR Phase II: Diffractive Imaging Micro-Spectrometer

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project seeks to develop miniaturized optical spectrometers with high resolving power and wide operating wavelength ranges. The realization of such devices will open up important new applications areas. Factors which have limited the usage of current spectrometers include their size, weight, complexity, and cost. This project seeks to use both integrated optical (that is, mainly 2D) elements as well as micro-optical (3D) components to create a new type of spectrometer. We propose a unique separation of functions between these elements that allows for miniaturization, which is not available with pure integrated optical or pure micro-optical designs. The 2D part of the microspectrometer is implemented in a planar waveguide. The 3D part is mounted on top of the waveguide slab.

The broader impact/commercial potential of these devices will be a broadband spectral sensor that is orders of magnitude smaller than the smallest devices currently available. This diffractive imaging micro-spectrometer is expected to promote transformative changes in industry sectors dealing with micro-systems that use optical spectroscopy.

Transparent Materials, LLC

Phase II Award No.: 1057826

Award Amount: $467,551.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Innovations in Nanoscale Manufacturing: Nanomaterial Composites for Dental Restorations

This Small Business Innovation Research (SBIR) Phase II project seeks to develop nanomanufacturing methods for producing nanocomposites for use in dentistry. Nanocomposites have shown great promise in dentistry but have limited applications because of the lack of reliable manufacturing methods to prepare them at scale. This Phase II project seeks to develop a new, highly-efficient and low-cost approach to the manufacture of these materials that allows their assembly from the individual components at the nanoscale. The process produces highly homogeneous nanomaterials with increased functionality. These materials simultaneously have multiple property enhancements such as radiopacity (aiding diagnostic capabilities), high strength and durability, and improved optical properties. This technology can be further leveraged to expand market opportunities into adjacent segments where cost constraints have limited the adoption of advanced nanocomposites.

The broader impact/commercial potential of this project is to provide nanomaterial composites that improve the function of dental restorations and of biomedical implants. The technology is anticipated to facilitate medical implant materials that better integrate into the human body, improve durability and use-life, and aid diagnosis, ultimately reducing the rate of revision procedures and improving patient outcomes. In the context of dental restoratives, these materials offer improved aesthetics, enhanced radiopacity for diagnostics, and state-of-the art strength and durability. The development and maturation of the proposed products will have significant impact upon the dental industry, allowing dentists to better diagnose recurrent caries, which will improve clinical outcomes and ultimately reduce the occurrence of clinical revision/replacement procedures. The cost savings associated with the new process will increase access of the general public to the highest quality dental restorations.

Universal Display Corporation

Phase II Award No.: 0948093

Award Amount: $499,999.00

Start Date: March 15, 2010
End Date: February 29, 2012

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: Novel PECVD (Plasma Enhanced Chemical Vapor Deposition) Single Layer Thin Film Encapsulation for Organic Devices

This Small Business Innovation Research (SBIR) Phase II project aims to develop a high-rate and large-area manufacturing process for a non-toxic barrier coating that can be used in flexible display and other applications. A flexible single-layer and environmentally-friendly barrier that has both inorganic and organic properties will be used to allow a much thinner barrier to be effective, thus significantly reducing the manufacturing costs.

The broader/commercial impact of this project will be the development of a cost-effective thin film encapsulation technology to enable a wide range of applications such as emerging display, imaging, battery and power generating technologies. These applications require a flexible, low-cost, and mostly transparent, thin permeation barrier to prevent oxygen and moisture from causing degradation. In this project, large-area scalability and ability to encapsulate devices made on flexible substrates will be addressed.

Whole Tree, Inc.

Phase II Award No.: 1026842

Award Amount: $500,000.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Coconut (Coir) Fiber Automotive Composites

This Small Business Innovation Research (SBIR) Phase II project will resolve the technical issues associated with scaling up the manufacturing of non-woven fabric composites made from a blend of coir fiber (from coconut husks) and recycled polypropylene. Final product variability due to the coir fiber itself, the milling of coir fiber from coconut husks, and the manufacturing process to make the felted composite, will be minimized. The variability of the coir fiber feedstock will be determined, along with the resulting variation of the composite's flexural stiffness. The most cost-effective production process to produce consistently clean, 2-3" long fibers in-country from husks will be defined. Finally, the manufacturing processes required to produce these coir fiber composites with the required consistency for automotive applications will be developed. This project will include continuous input from a major automotive manufacturer as well as an automotive parts maker. This research will result in an improved readiness of a polypropylene/coconut fiber based non-woven fabric composite that meets industry certifications for use in automobile trunk liners, and which is greener, less expensive, and better performing than current all-synthetic parts. The broader/commercial impact of this project will take many forms. The total market for automotive non-woven fabric composites is 300 million kg/year. Each vehicle platform that adopts this technology will require 2 million kg/year just for the trunk liners. Replacing synthetic fiber with coconut fiber makes parts more environmentally friendly while utilizing a waste material. Petroleum consumption can be reduced 2-4 million barrels per year and CO2 emissions reduced by 450,000 tons per year by replacing polyester fibers with coir in automotive interior composites.

Additionally, the improved performance and lower weight of these materials will lead to cost savings through increased fuel economy, saving up to 3 million gallons of gasoline per year in the U.S. Finally, this project will lead to great economic opportunities for poor coconut farmers and to a very positive environmental impact. Ninety-five percent of the 50 billion coconuts grown worldwide are owned by 10 million coconut farmers whose average income is less than $2/day. Approximately 85% of the coconut husks are currently disposed of as trash, creating pollution. The successful adoption of these materials would create a market for this material, in many cases doubling the annual income for these farmers.

Z4 Energy Systems

Phase II Award No.: 0924695

Award Amount: $491,291.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Program Director: Grace Jinliu Wang

Sector: Advanced Materials

SBIR Phase II: An Advanced Aeroelastic Thermoplastic Composite Blade for Residential-Scale Wind Turbines

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project seeks to prototype/validate a novel, self-regulating blade for a 3-kW Residential Wind Turbine (RWT). Successful development of this next-generation blade will eliminate major technical/economic drawbacks and reliability issues with current RWT's, and will promote widespread national and international commercial deployment of wind turbines. This project will demonstrate the following: 1) low-cost, durable, impact-resistant, mass-producible (and recyclable) blades; 2) self-regulation in high-winds and load mitigation in turbulence (allowing for reduced blade mass and cost); and 3) a simpler, more-reliable downwind turbine, for which the blades themselves protect the RWT in high winds and the cost and complexity of the tail and furling mechanism are eliminated.

The broader impact/commercial potential of this project enables the nation to meet or exceed ambitious industry projections, which state that 3% of U.S. electricity could be supplied by RWT's operated by a significant share of the 15 million households that have suitable land/wind resources. The timing for the breakthroughs being pursued by this project is ideal, as incentives similar to those offered for residential solar installations are being offered for RWTs. By substantially reducing the final market barriers of high cost and low reliability, this project will have a significant market advantage and will produce a next-generation wind-power technology that will allow individual households to make significant contributions to national energy independence and security.

ZT Solar, Inc

Phase II Award No.: 0924042

Award Amount: $516,000.00

Start Date: September 15, 2009
End Date: August 31, 2011

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Sector: Advanced Materials

SBIR Phase II: An Omni-Directional Antireflective Coating from Solutions

This Small Business Innovation Research (SBIR) Phase II seeks to develop a surface texturing technique that will significantly improve sunlight coupling into various types of solar cells. Surface textures are mandatory to record efficiencies in solar cells. The Omni-Directional Antireflective Coating (Omni-AR) solution showed a reduction in reflection in a large range of incident angles (omni-directional) over a broad spectral range (400-1200 nm). Improved solar cell efficiency of over 10% was demonstrated (experimentally).

The broader impact/commercial potential of this project will be a low-cost, broad-spectrum, omni-directional and substrate-independent surface texture antireflective coating. It is expected to have a significant impact on current and future solar cell technologies. The ability to provide near ideal performance of antireflective coatings to solar cells without a vacuum process is a major step in reducing the cost of solar electricity. This solution-based deposition technique makes it possible to provide a single coating technology that should work with all types of solar cell materials and structures. This project will significantly improve the conversion efficiency in both current and future solar cells (~10%) with a minimum cost increase (~4%). "This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)."

ADVANCED MATERIALS AND DEVICES INC.

Phase II Award No.: 0923869

Award Amount: $600,000.00

Start Date: August 1, 2009
End Date: January 31, 2012

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

STTR Phase II: Optimized Nano-Porous Surfaces for Boiling Heat Transfer

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer Research (STTR) Phase II project seeks to develop and commercialize an optimized technique to produce durable nano-porous surfaces (NPS) for heat transfer applications using an inexpensive electrochemical process. This technology will be very beneficial for the development of high-efficiency boilers, heat exchangers and electronic cooling devices.

The broader impact/commercial potential of this project will be the enhancement to boilers, heat exchangers, and electronic cooling devices that serve various industries, such as, power/utility, oil and gas, chemical, food and beverage, and building and construction. Additional benefit from the this project will be its potential application in efficient heat transfer to increase energy output, reduce energy consumption and greenhouse gases, consume less fossil fuels and reduce harmful pollution.

AppliFlex LLC

Phase II Award No.: 0924043

Award Amount: $615,988.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

STTR Phase II: Laser Vapor Deposition for thin film functional polymers and nanocomposites

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer Research (STTR) Phase II project seeks to commercialize an innovative technology for depositing thin films and heterostructures of functional polymers, functionalized nanoparticles and nanoparticle-loaded polymers. Laser vapor deposition (LVD - trademarked) can be used to increase efficiency and reduce cost of thin-film devices as varied as organic light emitting diodes (OLEDs), organic solar cells and polymer chemosensors. This project will prove that LVD can meet industrial production requirements by (a) performing scaling studies of the process-throughout versus laser power in various process configurations and (b) building a table-top mid-infrared laser prototype using nonlinear optical frequency conversion from a commercially available high-power near-infrared laser. This objective will be supported by thorough studies on the physical mechanism of laser-materials interaction under mid-infrared vibrational excitation. The outcome of this project will also provide the development roadmap for high power industrial lasers for materials processing applications in mid-infrared wavelength spectrum.

The broader impact/commercial potential from this technology will be the technique for mass production of thin-film organic optoelectronics devices. For example, the OLED is an energy-efficient display and solid-state lighting device. Widespread adoption of solid-state lighting products such as white-light OLEDs could cut the US consumption of electricity for lighting by 29%, while saving the nation's households about $125 billion in the process, according to the Department of Energy. It would also reduce America's dependence on foreign oil and reduce greenhouse gas emissions, thereby improving the environment. Furthermore, LVD will accelerate the penetration of organic electronics into the consumer space and create new applications such as flexible displays. Just as polymers have replaced metal in everything from children's toys to automobiles, polymers are revolutionizing electronics and optoelectronics by reducing costs and opening new markets for devices such as polymer electronics and nanostructured displays. In addition, the blueprint of table-top high-power lasers developed in this process will provide a new path into ultra-short-pulse laser materials processing applications in the near and mid-infrared.

Energy Research Company

Phase II Award No.: 0924394

Award Amount: $549,998.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: A New Method for Quantitative Calibration-Free Chemical Analysis

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to develop an analysis method based on plasma physics with unique advantages for in situ process control in coal-fired power plants and in metal and glass production. Software developed from this program will result in development of process control sensors capable of rapidly measuring the elemental composition of a material solely from the material's analytical laser induced breakdown spectroscopy (LIBS) spectrum. Analyses without calibration curves or standard reference materials (SRM's) would be revolutionary because conditions change and material compositions vary outside their expected range in industrial plants, rendering calibration curves inaccurate. Analytical LIBS could not be developed in the past because of these large uncertainties. This project will verify the algorithms developed are effective when applied to actual industrial materials: coal, aluminum, and glass. Coupling Analytical LIBS with a LIBS sensor for coal and patented LIBS probe for molten metals and glass will result in real time monitoring and control, a new and potentially paradigm shifting capability for these industries.

The broader impact/commercial potential of this project will be to the coal-fired power plants and manufacturing plants that produce glass, metal alloys, and other products by allowing the plant personnel to monitor the composition of their material continuously, which is currently impossible. Alloying and other mixing operations will be monitored in real time, eliminating errors in these operations. Increased plant output, reduced waste, and reduced energy expenditures per pound of product will result from problems in the production process being caught much more quickly. New manufacturing paradigms, such as continuous alloying of aluminum, are also made possible by development of this technology. Developing Analytical LIBS for the measurement of coal properties at electric utility power plants will increase their efficiency and optimize boiler performance. There will also be benefits in other fields such as atomic emission spectroscopy, plasma physics, and astronomy. Analytical LIBS can also be extended for accurate LIBS analyses of the environment (e.g. minerals, oceans, atmospheric aerosols), planetary science (e.g. Mars, moon, and comets), agriculture, and security (e.g. WMD detection). The development of Analytical LIBS for these fields is crucial because no standard reference materials (SRM's) exist for many of these materials, and hence accurate calibration curves are difficult to construct and will have limited utility.

EN'URGA INC

Phase II Award No.: 0923865

Award Amount: $516,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: Line Scan X-Ray Tomography for In Cylinder Diagnosis

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to develop a sound and novel Line Scan X-ray instrument to characterize turbulent sprays and flames inside a windowless combustor. This project will develop and evaluate a prototype system that will be used by the automotive and gas turbine industries. The goal of the project is a commercially available diagnostic technique for obtaining detailed characteristics of flames and sprays inside windowless combustors.

The broader impact/commercial potential of this project is that it will enable industry to measure relevant information inside combustors, permitting stricter quality control and reduced pollution emission. Significant advances in the combustion process are required to enable quantum improvements in fuel efficiency. This diagnostic tool will provide the information critically needed to enable improvements in fuel efficiency and pollution reduction.

FARADAY TECHNOLOGY, INC.

Phase II Award No.: 1057816

Award Amount: $500,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: Faradayic ElectroCell

This Small Business Innovation Research (SBIR) Phase II project will address a current limitation in manufacturing of electronic devices. At the heart of electronic device manufacturing is the production of printed circuit boards (PCBs), which provide the mechanical support and electrical connection for electronic components. Many reliability issues associated with electronic devices result from non-uniformities in the electrodeposited copper on the PCBs. The drive for improved electronic device performance has necessitated shrinking PCB feature dimensions and increasing complexity of features, which has exacerbated this problem. The objective of this project is to develop sophisticated electrolyte flow schemes that will specifically target manufacturing issues associated with shrinking feature sizes and increased PCB complexity. The development and optimization of these sophisticated electrolyte flow schemes will enhance PCB reliability as well as improve manufacturing throughput for next generation electronic devices.

The boarder impact/commercial potential of this project is the production of robust,lower cost electronic devices, which are found in a vast number of end-products,including critical defense, monitoring and safety systems used by the US government and military. The market for electronic devices, estimated to be about a $1.3 trillion dollar industry, is formed by various sectors including computer and office equipment, communication equipment, portable and consumer electronics, medical and automotive electronics. This technology specifically addresses the manufacture of printed circuit boards, a critical component of all electronic devices, which were estimated to be a $53.6 billion market in 2009. A large commercial driver for the ElectroCell technology is the ability to manufacture PCBs at a higher rate, improving throughput and lowering manufacturing costs. This will translate into lower cost electronics for consumers.

Industrial Optical Measurement Systems

Phase II Award No.: 0924053

Award Amount: $525,375.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Manufacturing Technologies

SBIR Phase II: Development of a Probe for Inspection of Transmission Valve Ports

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to commercialize technology for the inspection of cylinders with reflective surface finishes such as those found in the valve ports of valve bodies and pump covers of automatic transmissions. In order to achieve automated inspection stations with multiple probes in real time, on a production line, and in a factory environment many factors must be addressed such as: protecting the optical, electronic, mechanical and computing system of the probe from the factory environment, ensuring operability and maintainability of the probes on a high speed production line, and integration of the probe software into the computer system of a factory inspection station. Procedures to maximize useful information output must be developed that are easy for plant employees to use and understand. End user requirements for introducing new equipment into a production environment must be met including comparing the results of probe measurements with those of existing inspection techniques. The anticipated result will be a prototype valve port inspection system that can be used in a transmission manufacturing plant.

The broader impact/commercial potential of this project will be to inspect transmission valve ports for surface defects before the components containing them are assembled into valve bodies and pump covers. At the present time no automated inspection of this kind is being carried out. Valve bodies and pump covers are considered to contain defects only if they fail a leak test after they are assembled. This results in a range of variability in the quality of these components and in the performance and service life of the transmissions containing them. Reducing the variability and improving the quality of automatic transmissions could lead to more efficient vehicles with longer periods between transmission repairs and better fuel economy. It could also lead to a better scientific understanding of the effect of these defects on transmission performance and improvements in the manufacturing process.

Interlaken Technology Corporation

Phase II Award No.: 0923967

Award Amount: $548,022.00

Start Date: September 1, 2009
End Date: August 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

STTR Phase II: Development of an Innovative Warm Hydroforming System for Lightweight Alloys

This Small Business Technology Transfer Research (STTR) Phase II project seeks to develop analytical techniques for finite element simulations of the warm hydroforming of aluminum, magnesium and other metals. This project will develop and test fixtures and instrumentation. The project objectives will be to develop methods and a system for simulating parts and validating designs prior to prototyping and to develop advanced research warm hydroforming tooling with optical measurement capabilities to validate the simulation and modeling method. Warm hydroforming is of interest because many metals have improved forming properties at moderately elevated temperatures, 450 °C or less. Warm hydroforming differs from superplastic forming with a focus on conventional alloys and short forming times. Warm hydroforming also requires lower forces and pressures so the cost of heating can be offset by reduced mechanical system requirements.

The broader impact/commercial potential from this technology will be the ability for manufacturers to use lighter, more fuel efficient materials without sacrificing strength, (automotive and aerospace industries) or to obtain shapes not possible at room temperature. The value proposition offered by warm hydroforming is: lighter weight materials can be formed with similar strength characteristics, allowing for more efficient and environmentally friendly vehicles and aircraft; greater deformations can be achieved without tearing or fracturing reducing the need for machining or joining operations; allows the creation of many features, such as mounting points or reinforcing ribs, in a single step; eliminate process steps no longer needed with warm hydroforming since parts are formed in one operation; and lower up front capital costs as the force required to form materials at elevated temperatures is much lower than at room temperature and this translates into significantly smaller, less expensive presses and related equipment. While automotive warm hydroforming applications have had high visibility, many other industries such as heating and air conditioning, recreational vehicles and building products where aluminum components are used could benefit from this technology and by introducing this technology into those industries may make them more competitive and efficient. This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

Kurt J. Lesker Company

Phase II Award No.: 0923843

Award Amount: $525,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: Closed-Field Magnetron Sputtering with RF Plasma Enhancement for Deposition of Thin Films on Large-Area Flexible Substrates for Photovoltaics Applications

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to develop a turnkey sputter deposition system to provide low temperature thin film deposition of transparent conductive oxide (TCO) materials. A laboratory scale film deposition system using a closed-field magnetron sputtering with RF plasma enhancement was demonstrated. The thin films were grown at lower temperatures than most competing processes. One key advantage of the deposition process developed is its ability to produce TCOs without the need for post-treatments (to achieve both good resistivity and transparency) thereby simplifying the process compatible for high-volume processing of large flat polymeric substrates. The project will demonstrate the process compatible with alternative TCO materials and with photovoltaic applications.

The broader impact/commercial potential from this technology will be innovations in photovoltaic (PV) technology. The ability to tap solar energy more efficiently will lead to major breakthroughs for many devices. For years, silicon (Si) solar cells have been the backbone of the solar industry using monocrystalline Si substrate with multiple layers of p-n junction diodes. However, one of the main limiting factors is the shortage of silicon for PV applications as it competes with the existing requirements in the semiconductor industry. Many different PV alternatives are in active development which utilizes TCO materials to provide the conductive anode, cathode, or both. Thin film solar cells provide a good alternative to Si-based solar cells as long as the fabrication cost can be reduced. Thin film solar cells use layers of semiconducting materials with little micrometer thickness and deposited on glass, stainless steel or flexible substrates. One cost-effective method to produce PV devices is through the use of polymers. However, the current device performance of polymer-based PV devices is low but can further be improved by fabricating metal oxide semiconductors embedded on the polymer-based device structure. Thus, this technology will be cost-competitive if the fabrication of TCO thin films are proven they can be done on large-area flexible substrates at lower temperatures.

M4 Sciences, LLC

Phase II Award No.: 0822879
Phase IIB Award No.: 1027591

Award Amount: $1,023,660.00

Start Date: July 1, 2008
End Date: June 30, 2012

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

STTR Phase II: Modulation-Assisted Deep Hole Drilling of Micro/Meso-Scale Biomedical Components

This Small Business Technology Transfer (STTR) Phase II project aims to develop a Modulation-Assisted Machining (MAM) system with novel capabilities for micro/meso-scale deep-hole drilling of biomedical components. The system is structured around a new device; an accessory developed for computer numerically controlled (CNC) machine tools. This new device superimposes a low-frequency sinusoidal modulation onto machining processes enabling controlled chip formation and easy disposal, enhanced lubrication of tool-chip contact, reduces energy consumption, and, potentially, a reduction in tool wear. When implemented in the appropriate system framework, unprecedented increases in productivity and efficiency of deep-hole drilling processes are envisaged.

The broader impact/commercial potential of this project will be commercialize MAM technology in manufacturing of biomedical components and related applications in automotive and aerospace fluid systems manufacturing. Complemented by a strong education and training program. By driving the development of a class of clean machining processes with reduced effluent streams and energy consumption, and improved efficiency, this project will impact sustainable manufacturing for the discrete products sector, with broad societal benefits.

Magnetic Development, Inc.

Phase II Award No.: 0822525
Phase IIB Award No.: 1054621

Award Amount: $579,873.00

Start Date: July 1, 2008
End Date: June 30, 2011

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Program Director: Ben Schrag

Sector: Manufacturing Technologie

STTR Phase II: Condensing Ejector for Second-Step Compression in Reversed Rankine Cycle

This Small Business Technology Transfer (STTR) Phase II project seeks to continue the research and analysis of condensing ejectors for second stage compression in a refrigeration cycle. A condensing ejector is a two-phase jet device that produces outlet pressure higher than either of inlet pressures. The project combines theoretical and experimental models in order to design the condensing ejector for use in more efficient refrigeration systems. The results thus far show that the new design is capable of improving the efficiency of vapor compression refrigeration cycle by approximately one-third with R22 refrigerant. The goal is to draw closer to this ideal value with environmentally friendly refrigerants like R410A. The application of critical two-phase flow devices will lead to development of more efficient thermodynamic cycles for refrigeration and A/C and in the future possibly for propulsion and power generation.

The broader impact/commercial potential from this project will bring considerable economic and societal benefits by reducing our nation's dependence on foreign oil, improving safety of nuclear reactors and natural gas pipelines, and better understanding of phenomena of two-phase flow. Applications of the condensing ejector theory in heat pumps might promote use of renewable geothermal energy sources in the remote communities with limited energy choices. This project leads to enabling technologies by providing the technology platform for a new approach to evaluating two-phase flows. The capability to handle rapid phase change simulations has generated interest from the automotive industry to simulate flash boiling in automotive fuel injection. This project also provides the basis for establishing fundamentally new engineering and designing methods for equipment operating on two-phase flow.

MedShape Solutions, Inc.

Phase II Award No.: 0750247
Phase IIB Award No.: 1005971

Award Amount: $1,172,335.00

Start Date: January 1, 2008
End Date: June 30, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologi

SBIR Phase II: Shape Memory Polymer Based Orthopedic Fixation Devices

The Small Business Innovation Research (SBIR) Phase II project includes the design, development and commercialization of shape memory polymer orthopedic soft-tissue fixation devices. Current soft tissue fixation devices are primarily metal or plastic screws used to attach tissue grafts to bone in repair of torn anterior cruciate ligaments (ACL). These threaded devices commonly damage the tendon during insertion; reducing the effectiveness of the surgery. Shape memory polymers are a superior solution in that they can provide a simpler, stronger, and less damaging fixation method for these tendon grafts. Essentially, a shape memory polymer device can be; (1) delivered into the body in a compacted and less invasive state, (2) self-deploy at body temperature and (3) do so without sharp edges that might damage the tissue.

The proposed work has immediate commercial potential and direct societal benefit in the field of sports medicine with a significant market on the order of $210 million in ACL repair devices annually. Furthermore, the biomaterial developed for ACL reconstruction should have long-term impact on the 1.6MM orthopedic procedures performed each year to repair tendons and ligaments in knees, shoulders, and ankles and by reducing the invasiveness of surgery and improving the outcomes.

Micro Magnetics Inc.

Phase II Award No.: 0924685

Award Amount: $522,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: Ultrafast spintronic devices based on magnetic tunnel junctions using magnesium oxide (MgO) tunnel barriers

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will develop an ultrafast solid-state magnetic sensor using MgO-based magnetic tunneling junction (MTJ). The operating frequency range will span from DC to 2 GHz, the broadest among competing technologies. The sensor will have a compact size and high sensitivity and will operate at ambient conditions with no supporting system. The ability to mass produce these devices will provide a significant cost advantage.

There is a critical unmet need in ultrafast sensors. These sensors can perform non-destructive evaluation (NDE) of VLSI semiconductor chips, aircraft components and engine turbines, they will allow computers to process information faster in data storage devices, and they can be used to measure fast currents in devices such as antenna. The sensors hold great promise for monitoring the health of aircrafts. Ultrafast sensors can also monitor the performance of VLSI in failure analysis, enhancing the competitiveness of the semiconductor industry by shortening the development cycles. Knowledge gained in ultrafast sensor can be used to make faster data storage devices and build better national defense infrastructure.

OG Technologies, Inc.

Phase II Award No.: 1058237

Award Amount: $522,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: IPPM:In-Line Piercing Process Monitoring For Seamless Tube Manufacturing

This Small Business Innovation Research (SBIR) Phase II project proposes to develop an imaging based monitoring system for the piercing process used in the manufacturing of seamless steel tubes based on the feasibility proven in Phase I. Piercing is the core process of the near net-shape manufacturing process for seamless tubes, which are crucial materials in many critical applications ranging from energy to chemical, automotive, aerospace, and infrastructure. However, being the primary cause for tube wall variations and internal surface quality issues, piercing is rarely investigated due to the lack of proper sensing means. There is a need to improve the piercing process efficiency for higher product quality and lower costs with new sensors. The proposed innovation consists of a set of imaging sensors for measuring the vibrations of the part being pierced. The vibration signals are used for system conditions monitoring for the detection of critical failure modes. The new approach was validated on selected tubes. Further development is proposed to support the commercialization of a new piercing-monitoring system. This project will be carried out by a team of industry-academia collaboration in 24 months. A site-tested prototype will be delivered.

The broader impact/commercial potential of this project is substantial. This project represents a unique approach of multi-model sensor fusion to controlling a highly stochastic and non-linear process. If commercialized, it may improve seamless steel tubing manufacture through reduced mill downtime, fewer setup pieces, and tightened tolerances, thereby reducing the pollution emissions and costly energy consumption associated with remanufacturing or reworking out-oftolerance products. Industry-wide adoption in the tube industry could yield drastic reductions in waste byproducts and cost savings of $250 million per year. Scientifically, the proposed research could have an impact on the adoption of emerging high dimensional data analysis techniques. The proposed project carries strong educational implication due to the close working relationship with the academia. Social impact is also expected with this project in improved energy preservation and environmental protection. The estimated benefits include energy savings of 3 terawatt-hours and reduction of 300,000 tons of carbon-equivalent emission and 260,000 tons of toxic waste per year. The estimated market size for the proposed iPPM system is $15 million in the US and $200 million globally. Beyond the piercing process, the success of the project will also provide generic modeling and analysis tools for systems with complex information.

OMAX Corporation

Phase II Award No.: 1058278

Award Amount: $425,679.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Manufacturing Technologies

SBIR Phase II: Development of Subminiature Abrasive-Waterjet Nozzles toward Micromachining

This Small Business Innovative Research (SBIR) Phase II project aims to develop micro abrasive-waterjet technology for automated machining features between 50 to 100 micrometers. The challenge lies in the development of nozzles with beam diameters less than 100 micrometers. Several issues must be resolved due to the complexity of the supersonic, 3-phase, and microfluidic flow through micro abrasive-waterjet nozzles in which capillary dominates gravity. The required size of abrasives is so small that they tend to clump together with poor flowability under gravity feed, causing intermittent abrasive feed and frequent nozzle clogging. New concepts initiated by the company to resolve the above issues has proven to be very effective. In parallel, novel accessories are being developed to further reduce the size of features that cannot be accomplished alone by the nozzles. The micro abrasive waterject nozzles and accessories will be mounted on a multi-nozzle platform to upgrade existing waterjet equipment for micromachining and for enhancing productivity and/or integrated into a micro Jet Machining Center by combining them with a low-power pump and a small footprint platform tailored for low-cost micromachining.

The broader/commercial impact of this project is the versatility of waterjet technology ("5M" - from macro to micro machining for most materials) is to develop a new product line of low-cost micrometer Jet Machining Centers. To meet the urgent need for the affordability of the healthcare system, commercialization of micro abrasive-waterjet technology for low-cost manufacturing of biomedical components for orthopedic implants will be explored. The micro abrasive-waterjet technology would also advantageously apply to manufacture components of green energy products and microelectronics. With global emphasis on R&D in micro-nano technology, micro-nano products will be available commercially soon. The micro abrasive-waterjet technology would help accelerate maturing of that technology. By relaxing precision requirements, the micro abrasive-waterjet could readily be turned into an affordable prosumer/consumer product superior to conventional tools for fabricating art, crafts and jewelry. Small job shops would benefit from the cost-effective micro abrasive-waterjet technology since the initial investment for getting into micromachining has been cost prohibitive.

RES Group, Inc.

Phase II Award No.: 0750406
Phase IIB Award No.: 1007818

Award Amount: $1,004,721.00

Start Date: January 1, 2008
End Date: December 31, 2011

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Sector: Manufacturing Technologies

SBIR Phase II: Engine Combustion Simulator

This Small Business Innovation Research (SBIR) Phase II project aims to develop the Engine Combustion Simulator (ECS), an innovative software product that will enable researchers to develop and apply accurate chemical reactions for the design, control and optimization of the automotive engine and exhaust gas after-treatment devices. The ECS will reduce the costly and time-consuming experimental testing, as well as enable the researcher to probe concepts that are difficult or infeasible to test experimentally. These developments will accelerate the development of more fuel efficient and environmentally cleaner automobiles. At the core of the ECS is a suite of advanced database technologies and computational algorithms that enable the user to easily build accurate reaction mechanisms, and quickly perform simulation studies using these mechanisms.

The broader impact/commercial potential from this technology will result in cleaner and more fuel-efficient vehicles. Even a small gain in fuel efficiency can translate to billions of savings in fuels as well as reduced dependence on foreign oil. Less fuel consumption directly scales to reduction in emissions thus lowering of greenhouse gases while improving the human health. The ECS will be made available at no-charge for use in education and research in academia and some of the key components will be made available as an open-source to the research community to foster collaboration between researchers.

Seashell Technology

Phase II Award No.: 0924684

Award Amount: $455,854.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Manufacturing Technologies

STTR Phase II: Abrasion Resistant Ultrahydrophobic Coatings for Corrosion, Erosion and Wear Resistance

This Small Business Technology Transfer (STTR) Phase II project aims to further the development of abrasion resistant, environmentally friendly, ultrahydrophobic coating formulations. The ultrahydrophobic property is created by optimizing the coating matrices to generate a so-called "lotus leaf" structure that robustly repels water, preventing water penetration and accumulation. In addition to super water repellent activity, the self-cleaning coatings have a superior corrosion protection function. These properties reduce failure rates, increase life time, and effectively lower maintenance and replacement costs of the coated material. A major objective of the project is to refine the formulations to improve the performance properties. This ultrahydrophobic coating will be optimized for application on specific commercially important substrates such as plastic, concrete, asphalt, wood, glass, fabrics, and metal.

The broader impact/commercial potential of multi-functional coatings will be to provide improved, abrasion resistant ultrahydrophobic coatings for commercial applications in a variety of different areas such as shipping, automotive, building and aviation industries. These multi-functional coatings are environmentally compatible and will have a significant societal and environmental impact. "This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)."

Tetramer Technologies, LLC

Phase II Award No.: 0923988

Award Amount: $527,996.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Manufacturing Technologies

SBIR Phase II: Disruptive Performance From Engineered Piezoelectric Organic Polymer Nanocomposites: Inventive Approach To New Electrical and Mechanical Energy Conversion Materials

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to commercialize and expand the application of piezopolymer nanocomposite technology. Piezoelectric materials are an alternative energy source, which interconvert mechanical and electrical energy. Applications include transducers, actuators, sensors, energy harvesting, vibration dampening, and smart polymers. A strong market need has been for piezopolymeric materials that compete with the temperature and performance level of piezoceramics. In addition to films and fibers, this technology can form nonwoven fabrics, which are excellent geometries for smart materials and wound healing.

The broader impact/commercial potential of this project will be the transformation of new energy processes that play an increasingly important role to the public in the business and social foundation of the US as costs of fossil fuels rise. Alternative energy transformations such as solar, wind, biomass, wave and fuel cells are now more actively under commercial development and will no doubt continue to demonstrate growth technically and economically. Piezoelectric energy conversions are more versatile than those mentioned above. Benefits come in forms such as transducers, actuators, sensors, energy harvesting, vibration dampening, and smart polymers.

Topasol LLC

Phase II Award No.: 0924689

Award Amount: $474,043.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Sector: Manufacturing Technologies

SBIR Phase II: Low Cost-Reduced Risk Manufacturing Process For Nanocoatings

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to reduce the cost and risk of manufacturing nanoparticle/resin blends for coatings. Currently nanocoating resin manufacturing requires two steps; the first is the production of nanoparticles ex-situ of the coating resin using plasma or other energy intensive processes, and the second step is the addition of these nanopowders into the coating resin, usually by chemical processes and/or high energy mixing. Both steps are characterized by high cost, high environmental impact, or both. This new process reduces manufacturing steps, lowers cost and avoids direct exposure to hazardous nanopowders.

The broader impacts/commercial potential of this project is the creation of a roadmap for development of nanoparticle-containing coatings/composites by a one-step process. Potential cost savings are anticipated to be 25% or substantially more compared to existing processes. Coating performance enhancements not otherwise attainable are anticipated as well. Most importantly, health risks posed by inhalation of nanoparticulate powders, currently of unknown toxicity, are completely avoided. The largest potential of this project is the potential reduction of environmental, health and safety risks.

Triune Systems

Phase II Award No.: 1058114

Award Amount: $500,000.00

Start Date: January 1, 2011
End Date: December 31, 2012

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Sector: Manufacturing Technologies

SBIR Phase II: Micro-mark Data Matrix

This Small Business Innovation Research (SBIR) Phase II project will develop an Integrated Circuit (IC) authentication system as a countermeasure to the growing counterfeit IC problem. The goal is to leverage the extremely compact form factor of a patent-pending Micro Mark two dimensional (2D) direct part marking technology to apply permanent, unalterable, unique identification codes to individual IC packages. These codes will be generated from a centralized database then marked onto individual ICs such that they can be read and verified with the database throughout the subsequent supply chain to ensure traceability and authenticity. This Micro Mark technology is small enough (<25um) to fit on the vast majority of IC package form factors and provides sufficient code density to allow serialization.

The broader/commercial impacts of this project is to prevent the adverse effects of Integrated Circuit (IC) counterfeiting. ICs are a critical in the design of all electronic products and as our society becomes more and more dependent on electronic products for personal and business use it is important to ensure the correct operation of these products. This authentication system will enable manufacturers to ensure that the ICs they are deploying on their manufacturing lines are the authentic product. This system will also provide additional savings to the industry by reducing or eliminating the costs of manufacturing rework and product recalls due to counterfeit ICs. Moreover, as U.S. military electronic equipment has been infiltrated by counterfeit ICs, this authentication system will provide the systemic approach to stop the infiltration and preserve the performance of these military systems as they were designed and intended. As the technology matures, other industries which demand strict inventory control and efficient product recall (e.g. defense, pharmaceutical, legal, and forensic sciences) could also benefit from the Micro Mark Authentication System.

Advanced Diamond Technologies

Phase II Award No.: 0823002
Phase IIB Award No.: 1039753

Award Amount: $991,546.00

Start Date: August 01, 2008
End Date: July 31, 2012

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Program Director: Ben Schrag

Sector: Nanotechnology

STTR Phase II: Diamond Nanoprobes for Atomic Force Microscopy - Imaging, Metrology, Material Property Measurement, Process Control, and Manipulation with Ultrahigh Performanc

This Small Business Technology Transfer (STTR) Phase II project will develop commercially viable atomic force microscope (AFM) probes fabricated from ultrananocrystalline diamond. The project will refine the processes developed in Phase I and bring contact and non-contact all-diamond probes to market. Probes using conducting diamond that are chemically and electronically tunable and have superb tribological properties will also be developed.

This work will facilitate new industrial applications for AFM, including high-throughput imaging, metrology, and characterization of large quantities of materials, local electrical characterization for process control in micro/nanoelectronics, nanomechanical characterization of MEMS/NEMS devices, and ultraprecise hard mask correction for the micro/nanolithography industry.

Angstron Materials, LLC

Phase II Award No.: 1057999

Award Amount: $499,998.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Nanotechnology

STTR Phase II: Large-Scale Production of Pristine Nano Graphene

This Small Business Technology Transfer (STTR) Phase II project aims to develop a method for rapid, direct and large-scale production of pristine nano-graphene platelets (NGPs). A combined molecular dynamic, macroscopic modeling and experimental approach will be used to (1) further improve the understanding of the underlying principles behind effective peeling of single-layer graphene sheets from graphite particles in selected liquid mediums, and (2) to clearly determine the most critical processing conditions that govern the graphene production rate in a continuous processing reactor.

The broader/commercial impacts of this project will be the potential to offer a cost-effective method to produce pristine nano-graphene in large quantities. NGPs are of exceptional scientific and technological significance. The ability to produce large-volume pristine nano-graphene will have a profound impact on the evolution of nano-graphene science and technology. Highly conductive graphene may find practical applications in transparent and conductive coating, supercapacitor, battery electrode, fuel cell bipolar plates, and conductive nanocomposite.

Cosmas

Phase II Award No.: 0956628

Award Amount: $486,913.00

Start Date: March 15, 2010
End Date: February 29, 2012

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Sector: Nanotechnology

STTR Phase II: A Simple and Innovative Approach to the Synthesis of Metal, Alloy, Metal Oxide, and Mixed-Metal Oxide Nanoparticles

This Small Business Technology Transfer (STTR) Phase II project aims to develop a manufacturing process to synthesize metal oxide, sulfide and other nanoparticles. The subject method simply involves mixing of common dry chemical starting materials and heating the resulting precursor material to a modest temperature. The objective is to demonstrate feasibility and scalability of this low-cost manufacturing process. Methods of dispersing aggregated particles in aqueous and polar solvents will be also be investigated.

The broader/commercial impact of this project will be the potential to offer a cost-effective and environmentally-friendly process to produce a broad spectrum of high quality nanoparticles. Current methods of making nanoparticles involve heavy energy consumption, large amounts of waste, and/or purification problems. The synthetic approach in this project has the potential to become the method of choice to supply novel nanoparticles in many low to high technology applications. It is anticipated to obtain nanoparticles with particle sizes less than 15 nm, size variations within ±10-20%, and purities as high as 99.9999%.

Inlustra Technologies LLC

Phase II Award No.: 1058564

Award Amount: $423,988.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Nanotechnology

SBIR Phase II: Scalable Bulk GaN Crystal Growth

This Small Business Innovation Research (SBIR) Phase II project aims to grow gallium nitride (GaN) single crystals that are large enough to yield commercially-viable non-polar GaN substrates for optoelectronic devices. The feasibility of the crystal growth processes was demonstrated in Phase I. This Phase II project will focus on the reproducibility and scalability of the crystal growth and back-end processing methods. It is anticipated that the resulting per-unit price reduction will accelerate the adoption of GaN substrates by ultra-high brightness light emitting diode (LED) manufacturers.

The broader/commercial impacts of this project will be the potential to provide large-area non-polar GaN substrates for applications in advanced GaN-based light emitters such as laser diodes and ultra-high brightness LEDs. GaN-based LEDs present exciting long-term prospects for solid-state lighting, via the replacement of inefficient and/or toxic conventional light sources such as light bulbs and fluorescent lamps. However, the LEDs must be sufficiently low cost and demonstrate high luminous output power to justify the replacement of existing conventional lamps. GaN-based LEDs fabricated on non-polar GaN substrates that will be developed in this project has the potential to meet the most demanding lighting requirements, whereas conventional polar GaN-based LEDs ultimately cannot.

Inpria Corporation

Phase II Award No.: 1026885

Award Amount: $600,000.00

Start Date: June 15, 2010
End Date: May 31, 2012

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Directly Patternable Inorganic Hardmask for Nanolithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a robust, high-speed inorganic resist platform to revolutionize the manufacture of semiconductor devices with feature sizes < 30 nm. At present, there is no demonstrated organic or inorganic resist that satisfies all of the requirements - high speed, low line-width roughness (LWR), sufficient etch resistance - for patterning devices at these feature sizes. A fundamentally new approach, relying on depositing extremely high-quality oxide films from aqueous solution and very efficient photon-induced network-forming reactions, is being pursued. The approach has enabled the production of extremely small feature sizes and linewidth roughness, enabling optimization within a uniquely high-performance triangle of sensitivity, linewidth roughness, and resolution. Resist deposition, resist formulations, exposure conditions, and processing parameters will be examined in detail to simultaneously address International Technology Roadmap for Semiconductors (ITRS) roadmap requirements for 193i and extreme ultraviolet (EUV) lithography. Anticipated results include 26-nm line/space (L/S) resolution at 3 nm LWR with 193-nm exposures and double patterning, and 22-nm L/S resolution at 1.2 nm LWR with EUV exposures. This resist platform will also lead to a high-resolution electron beam resist with unprecedented sensitivity.

The broader/commercial impact of this project is to develop high-performance resist materials to fill critical unmet needs for semiconductor manufacturing with features smaller than 30 nm. The material being developed addresses two of the ITRS "difficult challenges" for lithography: an EUV resist that meets 22-nm half-pitch requirements, and the containment of cost escalation of the extension of 193 nm patterning. The resulting product will serve a quickly growing market with a combined opportunity of $250 million in 2015. Success in the project will have a considerable impact on continued productivity gains in the ITRS roadmap, which supports the electronics industry. New levels of device performance will be enabled, providing broad societal impacts through the introduction of advanced electronics, while enhancing prospects for domestic employment in advanced materials and semiconductor manufacturing. The broader scientific and engineering research communities will benefit from new techniques to build and study novel devices at the extreme end of the nanoscale. Finally, solution processing with aqueous materials will reduce the use of toxic solvents and permit a smaller carbon footprint from reduced reliance on vacuum process equipment.

Integrated Micro Sensors

Phase II Award No.: 1026825

Award Amount: $480,395.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Nanotechnology

SBIR Phase II: Metamaterials for Giant Dielectrics and Energy Storage Solutions

This Small Business Innovation Research (SBIR) Phase II project aims to develop a core-shell nanoparticle architecture with metal nanoparticles as the high capacitance core, and polymers as the shell. The nanoparticles will be entrained in a broad spectrum of host polymers via a novel approach to produce high dielectric-constant films with minimum dielectric loss. To scale up this process without losing the unique and valuable properties of core-shell nanoparticles, a wet chemistry route with laser for selective polymerization will be utilized to coat each metal nanoparticle with a polymeric shell.

The broader/commercial impact of this project will be the potential to provide high-dielectric constant nanoparticles for the development of nanocomposite to meet future energy storage needs of supercapacitors. Currently, commercially available supercapacitors either have too low power or energy density or are too expensive to manufacture. This project is expected to enable the fabrication of ultra high energy storage capacitors by providing high energy and power density in a cost-effective manner.

LUMARRAY INC.

Phase II Award No.: 0923893

Award Amount: $484,979.00

Start Date: August 15, 2009
End Date: July 31, 2011

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Program Director: Grace Jinliu Wang

Sector: Nanotechnology

SBIR Phase II: Dual-Wavelength Diffractive Optics for Absorbance-Modulation Optical Lithography

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to develop an optical-maskless-lithography technology that is capable of high resolution, high throughput, flexibility, low cost, and extendibility. Current lithography technologies suffer from the problems of high tool costs, high mask costs, and inflexibility (in the case of optical-projection lithography), or high tool costs, very low throughputs, and high complexity (in the case of scanning-electron-beam lithography). The emerging Zone-Plate-Array-Lithography (ZPAL) technology and its optical extension to sub-100 nanometers via absorbance-modulation optical lithography (AMOL) will mitigate these issues, while providing unprecedented flexibility in nanopatterning. The proposed project covers three major thrusts: firstly, the manufacture of zone-plate arrays containing over 1000 zone plates, each with a numerical-aperture (NA) greater than 0.85; second, the manufacture of dichromat arrays containing over 1000 zone plates, each with a numerical-aperture (NA) greater than 0.85; and lastly, the design of high-efficiency lenses to overcome many of limitations of conventional zone plates and dichromats.

The broader impact/commercial potential of this project is the creation of a fabrication tool which will enable a new paradigm in the development and manufacture of nanostructures by sharply reducing the development-cycle time and manufacturing costs. At present, the tools that are available for the creation of such nanostructures are highly limited in flexibility, resolution, cost and throughput. Being maskless, this technology provides flexibility by enabling the designers of nanostructures to quickly realize their designs in hardware for prototyping and even low-volume manufacturing. This new tool could potentially benefit a wide spectrum of industries including micro-electro-mechanical devices (MEMs), nano-electro-mechanical devices (NEMs), nano-electronics, nano-magnetics, integrated optics, photonics, biochips, and microfluidics.

LUMARRAY LLC

Phase II Award No.: 1058417

Award Amount: $499,868.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Grace Jinliu Wang

Sector: Nanotechnology

SBIR Phase II: Nanometer-Level Fidelity in Maskless Lithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a maskless photolithography system by ensuring that the patterns it writes are free of positional error (i.e., distortion) to the sub-1 nm level. In traditional photolithography, distortion minimization depends on the design and construction of an image-projection lens and on the fidelity of the mask. Measuring 1nm and sub-1nm geometric imperfections is intellectually challenging. In Phase I project, a confocal-metrology-system (CMS) was developed to determine focal spot positions from the phase of periodic signals produced when a master reference grating is scanned through the focal spots. In this Phase II project, corrections will be applied in the pattern-writing software. Errors in the X-Y position of the stage will be determined by comparing readings from a master reference grating with readings from the encoder built into the stage. Once known, systematic errors will be corrected in software through a process known as refracturing. The CMS will enable the systems located at disparate sites to reference a common fiducial, thus achieving identical patterning fidelity.

The broader/commercial impacts of this project will be the potential to provide a maskless photolithography tool with high fidelity for low-volume manufacturing of custom electronics and photonics, and for future nanomanufacturing. In comparison to existing electron-beam systems, this maskless photolithography tool will provide higher throughput, non-vacuum processing, large-area continuous patterning, lower cost and freedom from distortion to the sub-1nm level.

Nanosonic Incorporated

Phase II Award No.: 0924556

Award Amount: $500,000.00

Start Date: August 1, 2009
End Date: July 31, 2011

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Self Assembled Nanocrystal Thin Film Transistor

This project will develop and demonstrate large area and high performance nanocrystal thin film transistor (NC-TFT) based active matrix backplanes for flexible display applications. A novel electrostatic self assembly (ESA) technology will allow significant cost reduction using organic, inorganic and hybrid materials. Such a molecular-level self-assembly approach to form TFT materials and devices offers numerous advantages since very different materials can be incorporated uniformly, using the same chemical process at room temperature, thus allowing the formation of TFT films on virtually any substrate material. During Phase I, single and arrayed NC-TFT devices were developed on rigid and flexible substrates with reliability and performance comparable to that of amorphous silicon based TFT devices. High-K hybrid gate dielectrics, such as ZrO2/SiO2 hybrid thin films, were also deposited through the same ESA method. These films exhibited a dielectric constant larger than that of SiO2 (4.7 versus 3.9). Self-assembled gold nanoparticle-based memory devices. I-V tests were also investigated and fabricated. I-V tests were conducted on the self-assembled TFT devices, as well as on operational memory devices. The field effect mobility of the prototype TFTs can reach 0.3 cm2/V/s and an On-Off ratio of 1000 was achieved. We also fabricated TFT-based gas sensors, which demonstrated high sensitivity to certain gas species such as ammonia. In the current project, we will design and develop prototype NCTFT-based active matrix backplanes on flexible substrates with improved efficiency and performance and reduced cost, and beta-test those backplanes integrated with the E-paper based flexible display films and partners' flexible electronics and sensor platforms. This project also aims to establish a complete manufacturing process that is ready for production and licensing to selected flexible display customers.

The commercial potential is the development of flexible displays that offer many potential benefits over other display technologies, including reductions in cost, weight and power consumption, improved performance, ruggedness, and reliability. Other near term applications include 1) direct replacement for conventional circuit boards, wiring harnesses and flex interconnects on army vehicles, 2) as integrated sensing, signal processing and communicating clothing for army personnel, 3) electronic applications such as RF ID tags, antennas and stealth coatings, and 4) very large, mechanically-flexible deployable systems. This research has shown promise in producing devices of acceptable efficiencies at significantly reduced cost using organic, inorganic and conductive polymer materials. A revolutionary breakthrough in reducing the costs of TFT devices may be achieved if the semiconductor is deposited from solution onto large flexible substrates in roll-to-roll coating machines.

NAUGANEEDLES LLC

Phase II Award No.: 1058576

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Grace Jinliu Wang

Sector: Nanotechnology

SBIR Phase II: Batch Fabrication of High Aspect Ratio Metallic AFM Probes

This Small Business Innovation Research (SBIR) Phase II project aims to develop a low-cost manufacturing process to produce conductive and high-aspect-ratio probes for atomic force microscopy (AFM). A new fabrication tool with high-precision alignment and in-situ process monitoring sensors will be designed and constructed. The probes (so-called NeedleProbes) will be fabricated in a batch process that can pattern an entire wafer of conventional AFM probes with freestanding metal alloy nanowire tips.

The broader/commercial impacts of this project will be the potential to provide affordable, conductive and high-aspect-ratio AFM probes that would be well suited in biology for cell scanning and probing, and materials science for imaging of ultra-high-aspect-ratio structures, and electronic measurement of nanostructures. The current fabrication method of AFM probes is a serial process that produces approximately five probes per hour. The advancement in this project toward batch fabrication is expected to extend far beyond the current fabrication method and result in a price reduction of the probes by a factor of 5.

Omniprobe

Phase II Award No.: 0956765

Award Amount: $448,001.00

Start Date: February 15, 2010
End Date: January 31, 2012

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Sector: Nanotechnology

SBIR Phase II: Photon Enhanced SEM (Scanning Electron Microscopes) Platform for Nano-Manufacturing

This Small Business Innovation Research (SBIR) Phase II project aims to develop a platform for photon beam enhanced and electron beam induced nanoscale processing. Focused electron beam induced processing is a nanoscale process generally capable of about 10nm resolution and 1nm has been demonstrated. However, materials deposited via focused nanoscale electron beam induced deposition (EBID) contain significant amounts of residual contamination due to insufficient by-product desorption from the precursor molecules. In addition, electron beam induced etching (EBIE) is typically limited by desorption of the resultant electron beam induced etch product, thus is prohibitively slow. This project will address these limitations by developing an instrument capable of delivering a pulsed photon beam to facilitate desorption of contaminate by-products for the EBID process, and accelerate desorption of etch products during the EBIE process. The objective is to design and construct a platform capable of precise delivery of photons over a broad spectroscopic range for nanoscale processing and simultaneous microscale imaging in standard scanning electron microscopes (SEM) or dual ion and electron beam systems. Finally, requisite pulsed electron-photon-mass transport synchronization strategies will be developed for advanced nanoscale prototyping, editing, and sample preparation.

The broader/commercial impact of this project will be the development of a new tool to enable improved rapid prototyping of nanoscale devices by offering a cost-effective solution for nanoscale synthesis compatible with widespread SEM and dual beam platforms. This will accelerate the research efforts on next generation nanoscale devices with new and/or enhanced functionality, which is expected to benefit many facets of society ranging from physical to life sciences. This project may also improve the understanding of critical photon-electron-substrate-vapor interactions which will ultimately lead to a directed assembly approach capable of depositing 3-dimensional, complex and multi-component materials with nanometer scale lateral resolution and atomic scale z-dimensional control.

INDEX OF COMPANIES